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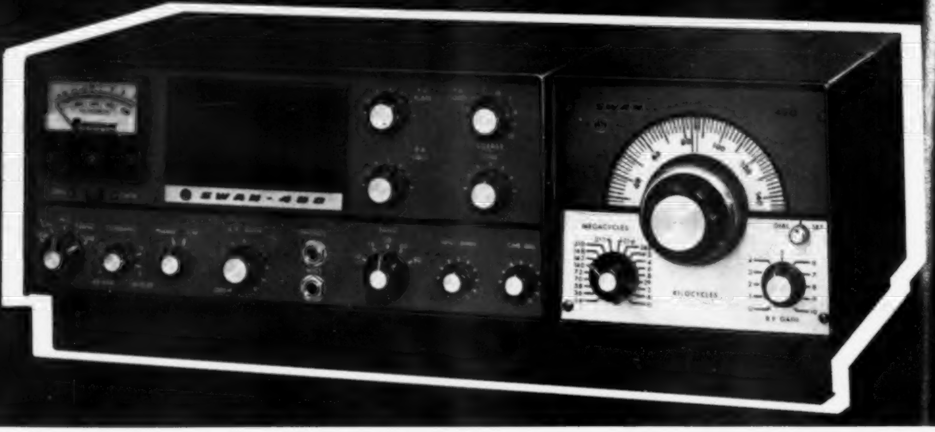

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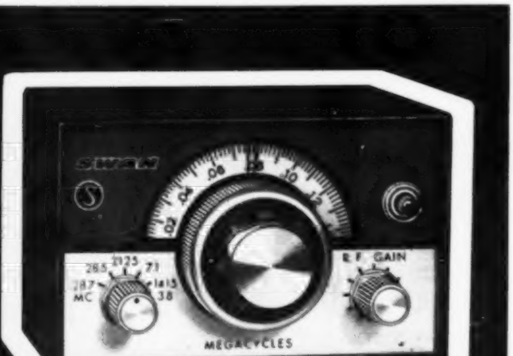

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73

Magazine

Wayne Green W2NSD/1
Editor, etcetera

June, 1964

Vol. XX, No. 1

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de W2NSD/1

never say die

The past few weeks have been eventful for amateur radio. The Institute started mailing its weekly newsletters to every U. S. Senator, U. S. Representative, Governor and government official involved with radio. This has met with an enthusiastic response.

First reports of the ARRL board of directors meeting indicate that it went off remarkably smoothly, considering the serious problems facing them from RM-499, dropping membership, the Coca-Cola scandal, and the disintegration of IARU Region 2. We'll all be watching for the minutes of the meeting in the July QST.

CQ devoted an editorial to me, for which I thank them. A couple letters from IoAR members cover this pretty well . . . see page 62.

The Dayton Hamvention went off smoothly in its new quarters. For the first time since I can remember people weren't jammed like the New York subways trying to get from one exhibitor to another. I've been pretty hard on the ARRL HQ for RM-499 and other things of late and I sort of expected to be taken to task by fellows that hadn't bothered to find out what was really happening. All I got was hundreds and hundreds of compliments for having the courage to bring points of dispute out in the open.

W3NL published a letter that I had sent to all ARRL directors well before the board meeting. I hadn't published this myself for I didn't want to have them think that I was making a grandstand play. The gist of the letter was that all of us will be watching the minutes of this years meeting to see which directors have shown initiative. I explained that I intended to use 73 this Fall to bring more light into the election of directors than they have ever seen before. I want to encourage intelligent dedicated amateurs to run for director and I am willing to devote space in 73 to their qualifications and their platforms. I also mentioned that I knew a simple way for the League to increase its yearly income by from $250,000 to $500,000. Only one director, Phil Spencer W5LDH from the Delta Division, answered my letter a all. Phil sent me a copy of the results of hi ballot on 499, mentioning that Huntoon refused to publish it. No one showed even slight interest in upping the ARRL income.

Point two of The Amateur's Code has alway bothered me a bit. "The Amateur is Loyal . . He owes his amateur radio to the America Radio Relay League, and he offers it his unswerving loyalty." Back in the early days o amateur radio there is no question that Hira Maxim did preserve ham radio. But during th 28 years that I've been following the hobby I don't know of any instance where the ARRL saved ham radio. What has the present generation of HQ men done to earn our unswerving loyalty?

Back in 1958 there was growing concern over the 1959 Geneva Conference and ARRL's lack of any program to counter the almost universal demand for a reduction in the amateur bands. When I talked with the heads and important officials of clubs in Europe I found them extremely critical of ARRL leadership. In 1959 I attended the Geneva Conference as a delegate and watched the miracle which saved our skins: the USSR and its satellites supported the U. S. proposal to put off frequency allocation changes until the next conference.

On my visit to Europe last October I did not find any increase in confidence in ARRL. The problem seems mostly to be a lack of any program. First reports of the IARU Region 2 meeting in Mexico City in April tell us that the delegates from South and Central American radio clubs listened to Hoover and Huntoon try to explain the ARRL/IARU "program" and ended up so furious that they refused to join the IARU Region 2 and set up their own separate organization, complete with officers (Antonio Pita, president) the Interamerican Amateur radio Union. They did permit the ARRL to join as long as they picked up 90% of the bill ($4500 worth of crow eating) for the meeting. Tempers flared and I understand that Hunty had to be shut up by the Panamanian delegate and was told that if he had anything else to say, to say it through his delegate, Mr. Dennison. (If I have any distortion of the actual facts I am most anxious to get corrections.)

73 is still unacceptable as an exhibitor at the Convention. Several manufacturers have written to say that they are going to pass it up as a result. I understand that the ARRL Directors were told that Harry Dannals W2TUK will be he official whipping boy for this one. Good

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choice. Should he decide to run for Hudson Division Director this fall we'll bring you a fascinating resumé of this guy.

Amateurs visiting the Fair will want to see the ARRL Sponsored station K2US in the Coca-Cola pavilion. It is difficult to find without exact instructions for it is well out of the path of the normal Fair goer. When you enter the Coca-Cola pavilion do not follow the main stream of the crowd off to the left, instead look for a stairway over on your right. Go up two and a half flights and then you'll see a small room with a place for a few people to peer through the glass. Only official HARC ops can operate the station, despite the ad in QST that all you have to do is show your ham license and you can operate. It is hard to believe the reports that the $75,000 a year man for Coca-Cola who made the deal with Hunty was forced to resign as a result. I don't know why Hunty decided that only Hallicrafters equipment could be used at K2US and I don't believe any of the explanations I've heard so far. It is a shame that Hallicrafters had to get stuck in the middle of this.

Enough people got upset over this whole matter so that the Pan American Radio Club in New York got permission to set up a ham station right on the ground floor of the Venezuelan Pavilion. This station, set up with equipment by National, Galaxy, Hammarlund, Waters, etc., will be on view to the millions of Fair goers and should accomplish the purpose of the ill-fated ARRL exhibit. The call of this station is WA2USA. All of us should be thankful for the interest and industry of this club which has resulted in ham radio really being seen at the World's Fair.

I notice that attention is being called to calls other than W2NSD that I have. The big station on 73 Mountain is licensed as W2NSD/1. The station at our HQ building is K1FYP. I also have a CB call of 2W3519 which was used last year in the hunt for a lost boy on 73 Mountain using two Johnson Messengers. I also have NØAOE in Navy MARS and used to have AF2NSD, XEØNSD, W4NSD,, FL8NSD, KC4AF, FØ8AS and others.

Speaking of the Mountain, we got back up there the other day for the first time since the snow melted and found that everything was in good shape. All of the towers and beams were still up in place. With the great emphasis that we are putting on the Institute I didn't see how we would be able to get the shack set up in time for the June QST contest. The 288 element two meter beam still has to have feed-

(Turn to page 75)

from 2 to 160 meters

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6 Meter AM and SSB Transmitter from the T-51A/ARQ-8

Leroy May W5AJG
9428 Hobart St.
Dallas 18, Texas

Photo credit: Jim Dungan, Dallas

The T-51A/ARQ-8 transmitter was one of a series of Radar Jamming units used in WWII. Exact operating details of this transmitter are not known to the writer but apparently consisted of a variable self-excited oscillator tube (6V6), driving on 832A mixer stage and this in turn driving the final 832A, or in some cases, an 829B. A noise source was injected into the 832A mixer stage via its grid circuit and mixed with the excitation from the 6V6 oscillator tube.

The frequency range was from approximately 30 mc to 100 mc, and made use of roller coil inductors (rollo coils), rather than the conventional LC circuits. This enabled the unit to cover this wide range of tuning. Some of the equipment came equipped with an 832A in the final stage and some units contained an 829B tube.

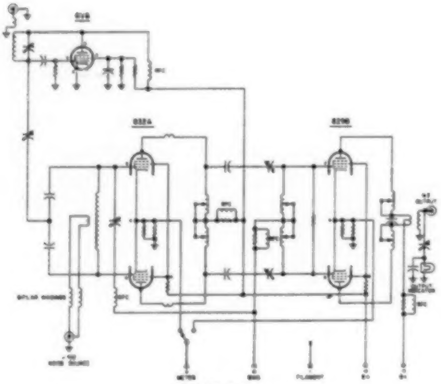


FIGURE 1

Original schematic

Upon inspection, it was felt this transmitter could be modified into a decent 50 mc unit without too many changes. This was done some four years ago and has since rendered excellent service. Actually, the unit is easily converted into an SSB exciter as well, and this was done at the same time with a second identical unit. The SSB version will be described later.

As an AM transmitter and/or exciter, this modified unit can use either an 832A in the final with an output of about 20 watts, or an 829B, with up to about 60 to 65 watts output. This represents 100 watts or so input power, in the latter case. This is the condition which we will describe.

The original circuit was wire traced and is drawn out in Fig. 1. The modified 50 mc AM transmitter is shown in Fig. 2. On the modified schematic, the original components are left unmarked, while the added or changed parts are so indicated with their values. This modified unit may be modulated, and if so, a modulator of about 50 watts or so will be required. The 829B operates as a Class "C" amplifier. A jack is provided for CW operation—and under such operation, the input can be jacked up a bit higher still, without damage to the 829B. Should the transmitter be used as an exciter to drive something more powerful, the T-51A/ARQ-8 plate voltage may be reduced until the minimum desired power output is reached to properly drive the high powered final.

Modifications

The photograph will show that the T-51A/

ARQ-8 has been mounted on a standard 7 inch rack panel by providing a square cut-out on the left and then fitting in the panel of the unit. It will be necessary to provide some additional enclosure shielding, since the original unit contains nothing in this line—having fitted into another type of case configuration. The rear photograph shows the works, less the aluminum back cover plate, but the shielding requirements may be gleaned nevertheless.

The first step in the modification process will be to scuttle the self-excited 6V6 oscillator tube and insert in its place, a crystal-controlled oscillator-doubler using a type 6AG7 tube in a familiar grid-plate arrangement. The crystal used is the common 8+ mc variety, and the 6AG7 plate coil is resonated to the second harmonic of the crystal, or 16+ mc. From this point, the excitation at 16 + mc is fed into the rearranged 832A tube which formerly was a mixer, but now will function as a push-pull tripler to 50 mc. This tube will in turn drive the final 829B stage as the straight through Class "C" amplifier.

The 832A tripler tube is lightly loaded and easily provides the necessary excitation to the 829B stage. In the grid circuit of the tripler the original grid coil is changed out to another type and the link from the 6AG7 is fed into the middle of this new coil. The 832A tripler plate circuit will use the original rollo coil. About 250 volts dc is ample for this stage plate supply.

The 829B final stage comes in for a bit more of a change, especially in the plate circuitry. The grid circuit of this stage will again use the original rollo coil for its tuning but the plate circuit makes use of a new LC combination. The reason is this: when the input power to the final 829B is stepped up to around 100 watts or so and the output runs in the vicinity of 65 watts, the original rollo coil in the plate circuit exhibits a bit too much heating and the rather small sliding contacts used in contacting the individual turns of the coil may start arcing when the unit is tuned under power. This condition cuts down on the efficiency of the final stage and prolonged transmission causes excessive heating. It was felt best to provide for something a bit more husky. This took the form of a dual-section, double-spaced variable capacitor and a new tank coil made of No. 12 enamelled wire, with a new two turn output link. If an 832A is substituted in the final, or if the 829B tube is throttled down in power input, this change in the final tank coil will not be necessary. No decrease in efficiency was noted when the power output was in the order of 20 watts or so, nor was heating any problem, so the removal of the original rollo coil will depend on just how far the user wishes to push the final stage.

Referring to the modified schematic, the only other additions of any import would be

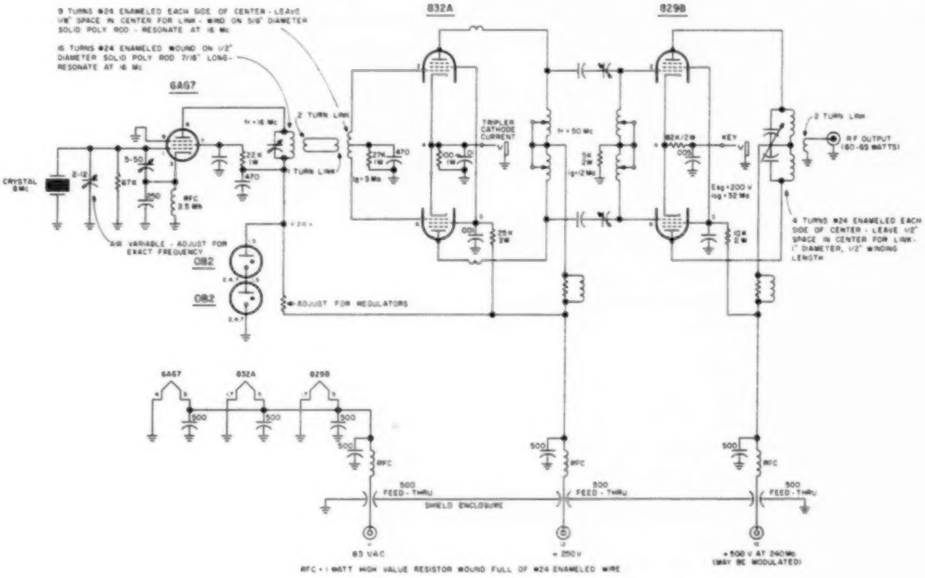
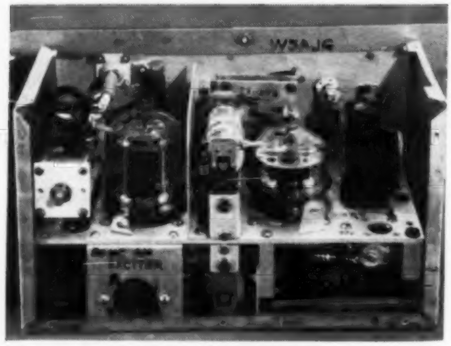

9 TURNS #24 ENAMELED EACH SIDE OF CENTER - LEAVE 1/8" SPACE IN CENTER FOR LINK - WIND ON 5/8" DIAMETER SOLID POLY ROD - RESONATE AT 16 Mc
16 TURNS #24 ENAMELED WOUND ON 1/2" DIAMETER SOLID POLY ROD 7/16" LONG - RESONATE AT 16 Mc
6AG7
832A
829B
CRYSTAL 8Mc
2-12
67K
5-50
RFC 2.5 Mh
22K 1W
470
2 TURN LINK
1 TURN LINK
27K 1W
100 1W
.01
TRIPLER CATHODE CURRENT
5K 2W
82K/2W
.005
KEY
Esg = 200 V
Isg = 32 Ma
10K 2W
25K 2W
2 TURN LINK
RF OUTPUT (60-65 WATTS)
4 TURNS #24 ENAMELED EACH SIDE OF CENTER - LEAVE 1/2" SPACE IN CENTER FOR LINK - 1" DIAMETER, 1/2" WINDING LENGTH
AIR VARIABLE - ADJUST FOR EXACT FREQUENCY
OB2
OB2
ADJUST FOR REGULATORS
500
RFC
500 FEED - THRU
SHIELD ENCLOSURE
63 VAC
+ 250 V
+ 500 V AT 240 Ma (MAY BE MODULATED)
RFC = 1 WATT HIGH VALUE RESISTOR WOUND FULL OF #24 ENAMELED WIRE

FIGURE 2
Modifications for AM



Rear view of T-51/ARQ-8 unit.
829B final on left of partition. 832A tripler and 6AG7 osc-doubler on right.
New 829B tank coil and capacitor can be seen, with output link tied into the coax output receptacle.
On the right the 6AG7 xtal oscillator and doubler tube replaces the original 6V6 self excited oscillator. The xtal trimming condenser is mounted on the panel. This allows exact freq. operation on nets, etc. (MARS).
A box is formed of aluminum for shielding. The back and top plates are removed for the photo. Power if fed in on the 4 prong receptacle.
Note: Since photo was taken, the above 4 prong receptacle has been replaced with a 5 prong MALE receptacle for safety purposes.

the filtering of the power leads. This is, of course, to obviate the TVI problem. This work may or may not be necessary, according to location and suspectibility to such trouble. No particular problem was encountered in this area after the shielding was incorporated. The filters in each power lead were inserted on the rear of an ordinary 4 prong receptacle carrying the voltages.

Operation

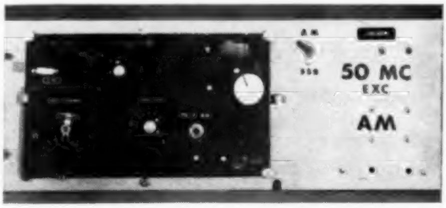
All coils are grid-dipped to their proper frequencies—the 6AG7 crystal stage output coil resonated at 16+ mc along with the new grid coil of the 832A. The original rollo-coils in the plate of the 832A and the grid of the 829B may be approximately set with the front dials to 50 mc and then grid-dipped to exact operating frequency. The newly added LC circuit in the plate of the 829B will also have to be checked and adjusted to 50 mc.

After this has been done, power may be applied and if no wiring errors have been made, all should operate as planned. Some sort of dummy load or wattmeter should load the 829B stage, before full power is revived up. The tripler cathode current will measure about 20 to 25 ma, while the final 829B cathode current (measured in key jack) may be run up to 240 or 250 ma or so with about 500 volts on the plate. This value will include 30 or 35 mills of screen current. Grid current to the final should measure 10 to 12 ma.

The low voltage tap of 250 volts dc should be capable of around 50 ma and may be a separate supply or any other way of providing such capability. Keying may also be accomplished by inserting a key in the "Tripler Cathode Current" jack if cut-off bias is furnished for the 829B final tube. This would be in the order of some 50 volts or so.

Should the unit be used as a complete AM Phone transmitter, the modulation transformer secondary should be inserted between terminal 13 and the power supply. Here at W5AJG this unit is used to drive a push-pull 4X250B final amplifier to 600 watts input when high-level, Class "C" AM operation is desired. The rf drive requirement in this instance is only approximately 10 watts or less so the T-51A/-ARQ-8 just loafs along. The actual plate voltage on the final is reduced ot 250v and plate current runs about 90 ma for our particular requirements as an exciter.

When it is desired to use the 4X250B final as a KW PEP linear in SSB service, the second T-51A/ARQ-8 unit modified as an SSB exciter-driver is switched into service in place of the above described AM unit.



Front panel view of the T-51A/ARQ modified unit.
A square rectangular cut-out in the rack panel is made to fit the unit into.
The white knob is the control for the new 829B LC tank circuit. A tripler MA jack is added in the place formerly occupied by a meter switch, which is no longer used.
The key jack is added in the place formerly occupied by the coax output RF receptacle. The new location of the RF output receptacle is just above the white knob.
The AM-SSB switch switches power from this unit to another identical unit, modified for SSB service.
The crystal sockets are installed on the rack panel for convenience. There is one on the inside of the unit but it is inconvenient to change crystals. Two different xtal sockets are wired in parallel so as to accommodate surplus type as well as FT243 type crystals.

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Model R-4 **$379⁹⁵** AMATEUR NET

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- **Crystal lattice filter 1st IF**
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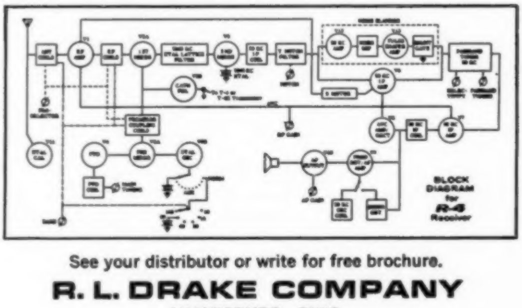
- **Receives SSB, AM, CW, and RTTY** with full RF gain, complete AVC action and accurate S-meter indication.
- **Product detector** for SSB/CW—diode detector for AM.
- **Excellent overload and cross modulation characteristics;** insensitive to operation of nearby transmitters.
- **Compact size; rugged construction.**
- **Transceive capability;** May be used to transceive with the T-4 "Reciter" or T-4X Transmitter.
- **13 tubes and 7 diodes.**



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SPECIFICATIONS— Model R-4

FREQUENCY COVERAGE: 3.5-4.0 Mc, 7.0-7.5 Mc, 14.0-14.5, 21.0-21.5, and 28.5-29.0 Mc with crystals supplied. Ten accessory crystal sockets are provided for coverage of any 10 additional 500 KC ranges between 1.5 and 30 Mc with the exception of 5.0-6.0 Mc.

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1.2 KC at 6 DB down and 4.8 KC at 60 DB down
2.4 KC at 6 DB down and 8.2 KC at 60 DB down
4.8 KC at 6 DB down and 25 KC at 60 DB down
Selectivity switching is independent of detector and AVC switching.

I.F. FREQUENCIES: First I.F.—5645 KC crystal lattice filter; second I.F.—50 KC tunable L/C filter.

STABILITY: Less than 100 cycles after warm up. Less than 100 cycles for 10% line voltage change.

SENSITIVITY: Less than ½ uv for 10 DB signal plus noise to noise on all amateur bands.

MODES OF OPERATION: SSB, CW, AM, RTTY.

DIAL CALIBRATION: Main dial calibrated 0 to 500 KC and 500 to 1000 KC in 5 KC divisions. Vernier dial calibrated 0 to 25 KC in 1 KC divisions.

CALIBRATION ACCURACY: Better than 1 KC when calibrated at nearest 100 KC point.

AVC: Amplified delayed AVC having slow (.75 sec.) or fast (.025 sec.) discharge; less than 100 microsecond charge. AVC can also be switched off. 3 DB change in AF output with 60 DB change in RF input.

AUDIO OUTPUT: 1.4 watts max. and .5 watts at AVC threshold.

AUDIO OUTPUT IMPEDANCE: 4 Ohms and hi impedance for anti-vox.

ANTENNA INPUT: Nominal 52 Ohms.

SPURIOUS RESPONSES: Image rejection more than 60 DB. I.F. rejection more than 60 DB on ham ranges. Internal spurious responses in ham ranges less than the equivalent 1 uv signal on the antenna.

FRONT PANEL CONTROLS: Main tuning, AF gain, RF gain, AM-SSB/CW with slow AVC, fast AVC, or AVC off, function switch, band switch, xtal switch, passband tuning and selectivity, preselector, notch, and headphone jack.

REAR CHASSIS JACKS AND CONTROLS: S-meter zero, notch adjust, antenna jack, speaker jack, mute jack, anti-vox jack, accessory power socket, and fuse post.

POWER CONSUMPTION: 50 watts, 120/240 VAC, 50/60 cycles.

DIMENSIONS: 5½" high, 10¾" wide, cabinet depth 11⅝", overall length 12¼", weight 16 lbs.

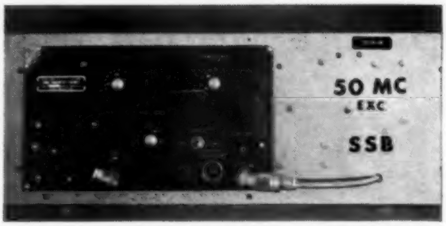
AVAILABLE ACCESSORY: Model MS-4 matching speaker cabinet with high efficiency 5 x 7 speaker. Cabinet also houses the power supply for the T-4 or T-4X matching transmitters.

SSB Conversion: Another identical T-51A/-ARQ-8 unit was converted into a 50 mc SSB exciter or transmitter. Using the same technique of changing final amplifier tube types, the PEP SSB input can be anything from about 35 watts to 150 watts. Should the unit be used as a driver for a higher powered AB1 amplifier, the output can be lowered by using the smaller final tube, while the larger tube may be used should the T-51A be utilized as a complete transmitter.

Modifications

Since the requirements at this station dictated the modified unit be used for exiciter service to drive a 4X250B push-pull final, running the maximum power, the drive requirements were very modest and the lighter 832A tube was used in the final stage, instead of the heavier 829B tube. However, both conditions will be described and typical characteristics will be listed.

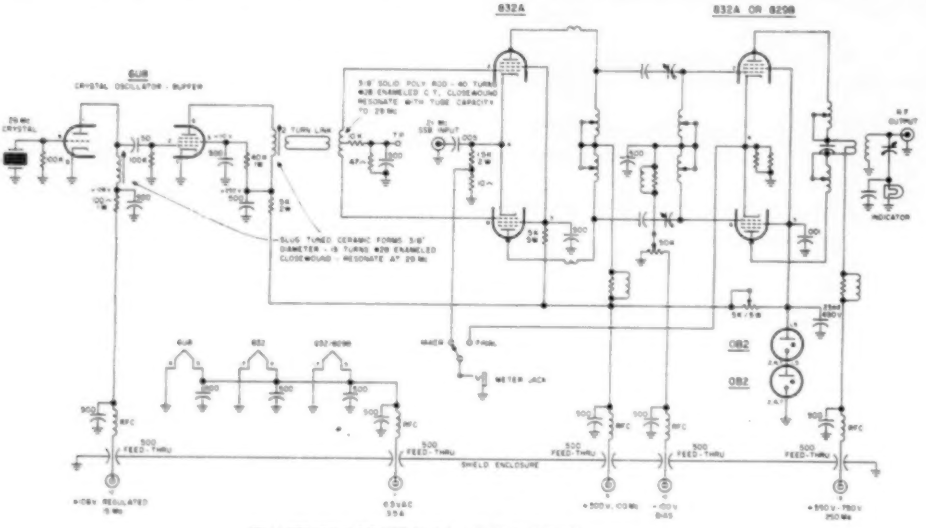
Referring to the two photos and the unmodified schematic as well as the modified schematic (Fig. 3), it can be seen that this conversion, like the previous one, mounts the unit on a standard 7 inch rack panel, in precisely the same way as before. Also followed, is the identical arrangement of enclosure shielding on the rear of the panel. The rear view illustration shows this once again, with the top and back aluminum shields having been removed.


50 MC
EXC
SSB

Front panel view of modified T-51A/ARQ-8 unit. Unit is mounted on a standard 7 inch relay rack panel. Original oscillator tuning capacitor dial has been removed. 21 mc SSB input energy goes into the coax receptacle so marked.
The phone jack is for the plugging in of a mill-meter to measure cathode current of the mixer and final.

The first step in this SSB conversion will be to replace the original 6V6 self-excited oscillator tube and substitute a crystal controlled oscillator-buffer stage using a type 6U8 tube. Before we do this however, a word about the proper injection frequency and the appropriate crystal frequency necessary.

All VHF SSB work at this station is done with a basic Central Electronics 20A unit and at an output frequency of 21 mc. Therefore, the wanted crystal injection frequency will be around 29 mc. Since the 50-54 mc band will take in 4 mc and since vfo used with the 20A does not cover but 500 kc, it will be necessary to have more than one crystal to use with the T-51A unit if the full 4 mc range must be


6U8
CRYSTAL OSCILLATOR - BUFFER
29 mc CRYSTAL
100K
50
100K
500
40K 1W
100 ~ 1W
500
500
5K 2W
2 TURN LINK
3/8" SOLID POLY ROD - 40 TURNS #28 ENAMELED C.T. CLOSEWOUND RESONATE WITH TUBE CAPACITY TO 29 mc
10K
47~
500
TP
21 mc SSB INPUT
.005
15K 2W
10~
SLUG TUNED CERAMIC FORMS 3/8" DIAMETER - 13 TURNS #28 ENAMELED CLOSEWOUND - RESONATE AT 29 mc
832A
832A OR 829B
500
5K 5W
500
50K
.001
R.F. OUTPUT
INDICATOR
5K / 5W
25mf 450V
OB2
OB2
6U8
832
832/829B
500
500
500
MIXER
FINAL
METER JACK
500
RFC
500
RFC
500
RFC
500
RFC
500
RFC
500 FEED-THRU
500 FEED-THRU
SHIELD ENCLOSURE
500 FEED-THRU
500 FEED-THRU
500 FEED-THRU
+105V REGULATED 15 ma
6.3VAC 3.5A
+300V, 100 ma
-100V BIAS
+550V - 750V 250 ma

RFC = 1 WATT HIGH VALUE RESISTOR WOUND FULL OF #24 ENAMELED WIRE

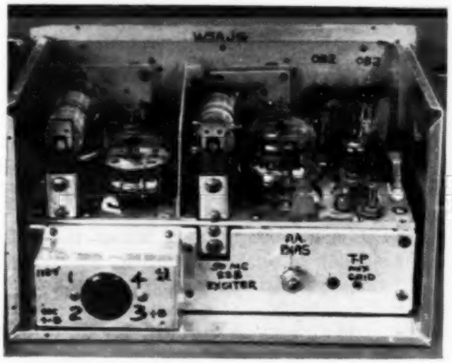
FIGURE 3
Modifications for SSB

covered. This is a common occurence these days, even with expensive manufactured equipment. One will just have to choose the portion of these wide bands that most appeal to his needs and furnish crystals to cover these segments. Since most side-banders on 50 mc still seem to favor low end operation, it will probably be the most desirable to cover the first 500 kc of the 6 meter band, at least for a start.

This being the case then, a crystal of 29 mc for the injection string will be used. This added to the 21 mc SSB from the 20A will mix in the first 832A mixer tube to produce the desired 50 mc output. The final 829B (or 832A) will then serve as the class AB1 linear output stage.

Other frequencies than 21 mc for the SSB energy may be used, of course. 14 mc is widely employed for this same purpose from the SSB generator and should this frequency be desired, it will merely be necessary to change the crystal string to 36 mc, instead of the 29 mc as shown. This merely involves three coil forms and is of small significance.

Back to the 6U8 oscillator-buffer. For good stability, the oscillator plate voltage supply is regulated at 108 volts. This low voltage is entirely adequate as the pentode section of the 6U8 will furnish sufficient drive for the 832A



Rear view panel photo of the T-51/ARQ modified unit.
Final shows 832A tube in place, but 829B tube may be inserted for additional power output. New 6U8 xtal-oscillator, buffer tube at right. 29 mc xtal also seen. OB2 regulator tubes in series, regulate the final screen voltage. Capacitor with slotted shaft is not used and has no function.
Power input is 4 prong socket at left. Since photo was taken, this female socket has been changed to a male type for safety reasons. The 110V (Pin 1) on this socket is fed from a small 6.3v to 115v transformer reversed. This transformer is located at another point than the unit itself, and is not visible in this photo.

$59.95
amateur net

Introducing the TR-44, a high-performance rotor system for the Amateur on a budget who's ready to upgrade his antenna installation.

The TR-44 approaches the accuracy and ruggedness of the famous Cornell-Dubilier HAM-M but is designed specifically for intermediate loads.

Check these features:

- Control box contains the HAM-M meter.
- Dimensionally identical to TV rotor types AR-22, TR-2 and TR-4. The TR-44 even fits the same bolt holes!
- End of rotation electrical motor cut-off.
- No mechanical clanking, no electrical pulse noise.
- Increased rotational torque…up to twice as much as TV rotors!
- 48-ball bearing movement.
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If you are now getting marginal results using a TV rotor, the TR-44 is for you! It will give you the increased torque, braking and accuracy that are needed for large VHF arrays and small HF combination antennas. For technical information, contact Bill Ashby K2TKN or your local CDE Distributor.

CDE makes a complete line of the world's finest rotors: the HAM-M; the new TR-44; heavy-duty automatic TV; heavy-duty manual TV; standard-duty automatic TV; standard-duty manual TV; and the industry's only wireless remote control rotor system! Cornell-Dubilier Electronics, Div. of Federal Pacific Electric Co., 118 East Jones St., Fuquay Springs, N. C.

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the only Company that makes them all

mixer grid. A couple of ordinary slug tuned coils are utilized in this stage. They should resonate at 29 mc and the output buffer has a link of a couple of turns on its cold end to couple to the new 832A mixer coil. This added coil is also resonated with tube capacity to 29 mc. Normally, no external front panel tuning is necessary on this stage and when the slugs are once set for maximum output, they need not be changed unless one moves a megacycle or so; therefore, the original tuning dial for the old original 6V6 stage is removed from the front panel.

The 21 mc SSB input from the 20A is injected into an existing coax receptacle, marked OSCILLATOR, mounted out front, but it is rewired into the 832A mixer tube cathode instead of into the grid circuit as per the original installation, (J102). An effort was made to use the same type injection scheme as per the original installation—that is, mixing the injection frequency as well as the external frequency (SSB) in a common point through the original bifilar wound coils and J102. While this did work after a fashion, instability was encountered with certain setting of the rollo coils. Apparently a TNT action took place. With cathode injection of the SSB energy, no instability could be made to occur with any setting of the tuned circuits. Control grid as well as screen grid injection of the SSB energy were also tried and all were about on a par with cathode injection, so any method could actually be used. Cathode injection is easy to accomplish. Any SSB exciter like the 10B or 20A with a few watts output is sufficient for driving.

To continue: the 832A mixer plate circuit will use the original rollo coils, as well as the grid circuit of the final tube. Plate and screen voltage on the 832A mixer is derived from a power supply of 300v capable of about 100ma drain. This supply will also furnish power for the pentode section of the 6U8 buffer, and in conjunction with a couple of series OB2's (regulators), the screen voltage for the final tube screen.

The plate circuit of the final tube will likewise use the original rollo coils and as stated in the preceding on the AM version of the T-51A, no heating will be experienced in this low duty cycle SSB work, which is in contrast to the heavy duty cycle of AM type operation. Therefore, the output circuit of the final will remain practically intact, even to the existing indicator (rf) light feature, should you find this is attractive. It will be necessary to provide some fixed bias for the final 832A/829B linear stage. This can be conveniently done with a small silicon diode rectifying the 115v ac provided by a reversed 6.3 to 115v ac transformer, and providing a variable pot for proper adjustment. This pot is mounted on the rear apron of the chassis and the negative bias of about −90 volts is brought in on terminal 10 of the original terminal strip. The proper adjustment of this control will be covered very shortly.

The original meter switch is left intact on this version of the unit and in conjunction with a jack installed on the panel, is convenient to check the cathode currents of the mixer and PA stage. Other details of construction, such as the necessary shielding and the filtering of the power leads will be identical with the previously described unit.

Operation

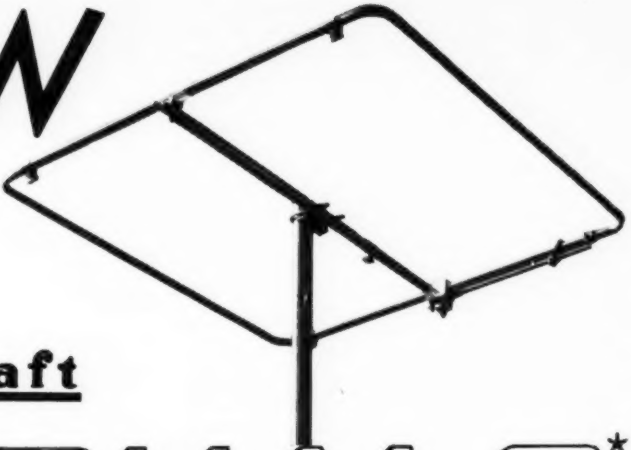
Install either the 832A or the 829B in the final stage according to power output required. Plate voltage should be supplied from an external source of from 500 to 750 volts maximum. For full output, the supply should be capable of about 250 ma or so. The only change necessary from using one tube or the other will be the screen grid dropping resistor from the 300 volt supply. This will have to be adjusted a bit to provide proper operation of the OB2 regulators. This variable resistor can take the form of a 5k, 5 watt unit and will allow either tube to be used.

All the coils are grid-dipped to their proper frequency. The two slug tuned coils associated with the 6U8 want to resonate at 29 mc approximately. Same for the grid coil of the 832A mixer. The rollo coils of the mixer plate, the final grid and the final plate, will of course, be set at 50 mc. This can be done fairly closely, for a start, with the front panel dials.

After this has been done, power may be applied and if all wiring is OK, things should start to happen. To begin with, do not apply any SSB energy. With the switch set to check the cathode current of the final stage, set the negative bias pot until the resting cathode current is about 18 or 20 mills. This will do for now. The test point "T-P" in the mixer grid circuit may be checked at this point, and the crystal injection string from the 6U8 peaked up, until a maximum is indicated, as read on a sensitive VOM. Checking the cathode current of the 832A mixer should show around 15 mills or so. No output should be observed from the final as yet.

Now connect the SSB 21 mc input up to the front panel coax-receptacle and turn on the 20A or whatever unit is used. Crank in a bit of re-inserted carrier and trim the three rollo coils until some 50 mc output is indicated in

NEW



Cush Craft

SQUALO*

6-10-11-15-20 or 40 METERS

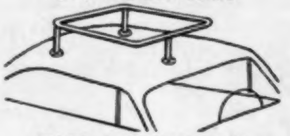
Cush Craft's continuing research produces another first —THE SQUARE HALO. Squalo is a full half wave, horizontally polarized, omnidirectional antenna. Outstanding all around performance is achieved through a 360° pattern with no deep nulls. Full size and compact dimensions provide a low Q for broad band coverage. Direct 52 ohm Reddi Match feed gives an SWR of 1.5-1 or less from 50 to 51 Mc.

The 6 and 11 meter Squalos are packaged complete with rubber suction cups for car top mounting and a horizontal support for mast or tower mounting. The 10-15-20 and 40 meter Squalos are designed for mast or tower mounting where space does not allow for larger antennas. Squalo is ideal for net control, monitoring, or general ham coverage.

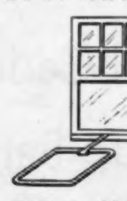
Whether you are a beginner, apartment dweller, or serious DX man the space saver Squalo is for you. You can buy one for each band and build a Squalo Tree!

Model No.	Description	Net Price
ASQ-6	6 meter 30" square	**$12.50**
ASQ-10	10 meter 50" square	**19.50**
CSQ-11	11 meter 50" square	**19.50**
ASQ-15	15 meter 65" square	**23.50**
ASQ-20	20 meter 100" square	**29.50**
ASQ-40	40 meter 192" square	**66.50**

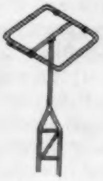
ON YOUR CAR



OUT A WINDOW



ON A MAST



*Pronounced Squaylo

Cush Craft

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the dummy load or wattmeter or whatever is hooked on to the unit. At this point, all coil slugs, rollo coils, 20A output circuits, etc., should be peaked for maximum 50 mc output from the T-51A. From here on in, everything should be more or less routine and adjustments of voltages and output may be set as desired. It will be advisable to let the triode oscillator section of the 6U8 tube run continuously between transmission for the best SSB stability.

As for power delivered: should the 832A be used in the final, an input of about 35 to 45 watts may be used. This will result in an output of around 17 to 20 watts PEP and will be more than sufficient to drive any type of grounded cathode final to maximum power. In actual practice, here at W5AJG, the plate voltage on the 832A final is run at about 375 volts and an input of only 10 or 11 watts is needed to produce the 4 or 5 watts PEP output necessary to drive the station final, which is a pair of 4X250B's in push-pull, to more than a KW PEP input.

Should the T-51A be used as a complete transmitter without another higher powered final, then of course the choice would be the 829B tube in the final socket. This tube will allow an input of some 120 to 150 watts PEP and will deliver on the order of 65 to 75 watts PEP output. This unit was checked out with an 829B tube and a plate supply of 600 vdc. The screen was of course regulated at 216 volts. Final bias was −30v. Resting plate current was 20 mills. With a two-tone test signal driving the final plate current to 100 mills, an output of 40 watts was measured. Speech easily drives the PEP output to the above 65 watt figure, when up to 750 volts is applied to the plates of the final. The rollo coils will hold tuning over a range of about 400 kc before re-adjustment becomes necessary.

A standard Drake transmitting low-pass filter (TV-1000-LP) is used on the output of this transmitter when feeding the antenna. No trouble with TVI in this area was encountered. Channels in use being 4, 5, 8, 11 and 13.

Some workers have reported an interesting variation in the modification process on such a unit as this. Instead of using the 6U8 oscillator-buffer stage as described above, an International Crystal Company ready-made unit, such as the 200-125, or an earlier version, was installed. This was accomplished by removing the 6V6 oscillator tube and all components associated with it, and sub-mounting the assembly under the chassis. The hole left by the 6V6 tube socket removal allows the 6AU8 tube to protrude slightly above the deck.

Many thanks to K5KLU for his help in the modification and the testing of the T-51A/ARQ-8.

. . . W5AJG

The Nickel-Cadmium Storage Battery

Robert MacDonald W4VGS/1
7 Sherman Street
Needham Heights 94, Mass.

You have probably noticed in the surplus columns of various Ham magazines that nickel-cadmium batteries have finally become availabe at reasonable prices. In case you have been looking for a compact, reliable, portable and re-chargeable source of power, you should consider these devises. The purpose of this article is to supply you with the information you will need to make proper use of these little wonders.

Specifications
(For the BB-403 series)

1. Dimensions: Approximately 2" W. x ½" D. x 6" H.
1. Capacity: 4 Ampere hours at 1 ampere rate.
3. Voltage: 1.2 Volts per cell.
4. Venting presure: 1 to 3 PSI.

While the ampere hour rating is 4 A.H., it might be interesting to note that these cells will suply peak currents up to about 40 amps. Cells are shipped from the manufacturer with shipping plugs installed in the vent wells. However, the cells you will buy should have *vent* plugs installed. These are in the form of hollow screws, around which rubber sleeves are fitted, and are designed to release gasses produced while charging the cells, and to prevent foreign material from entering the cells, or electrolyte leakage.

Life expectancy of these cells is not precisely known. However, I understand they should last in excess of 20 years!

Preparation For Service

Carefully examine cells for cracks, and if any are evident, fuse the cracks with a hot soldering iron. Then clean the cells thoroughly with distilled water and a brush. Wipe dry or allow to air dry, remove vent plugs and soak them in distilled water for at least an hour. Check electrolyte level and add electrolyte if necessary to bring level up to ½" over the tops of the plates. Do not raise level more than ¾" above the tops of the plates, as the solution will rise during charging.

Electrolyte consists of a 33% solution of potassium hydroxide in distilled water and may be purchased from your local pharmacy. This solution is very caustic and will wreak havoc with anything upon which it is spilled; it is also very poisonous and should be kept in a clearly labeled bottle far from the reach of children.

Addition of electrolyte to cells is easily accomplished by filling the vent wells while squeezing the cells and then releasing the pressure applied by squeezing. An eye dropper is very handy for this operation. It is probably wise to discard any eye dropper used for this purpose. After electrolyte level has been adjusted, replace the vent plugs and tighten securely.

Equalization

Equalize cells by discharging at a 4 ampere rate until voltage reaches 0.9 volts. Short cells and leave shorted for at least one hour. Allow cells to cool before charging, then charge according to one of the following procedures.

Charging

If the state of charge of individual cells is not known, always equalize, using the procedure described above. Generally, if cells have been inactive for more than two weeks, or if they have been floating (trickle charging) for more than a month they should be equalized. This is particularly important if you wish to charge cells connected in series.

Method 1: (Constant Current) Charge at 1 ampere for minimum of 5.6 hours.

Method 2: (Constant Current.) Charge at 0.8 to 2.0 ampere until cell voltage reaches 1.55 volts; continue charging at 1.3 amperes for 1 hour.

Method 3: (Constant Voltage.) Charge at 1.5 volts for 1 hour. This method is recommended when cells are completely discharged and rapid restoration is important.

Method 4: (Constant Voltage.) Charge at 1.5 volts for 1 hour. This method is recommended when cells are not completely discharged, are in a questionable state of charge, and when a full charge is not required.

CAUTION: When using constant voltage methods, the charger should be capable of supplying peak currents in the order of 40 amperes and continuous currents of 6 amperes.

Method 5: (Trickle charging or floating.) In order to maintain cells in a fully charged condition, charge at a constant current of 15 to 30 milliamperes, or float by connecting cells to a constant voltage buss which will supply 1.55 volts. These procedures are useful when cells must be used occasionally, and relatively long periods of activity will allow cells to charge back to full capacity at a slow rate. However, after several months of floating or trickle charging, cells should be equalized and recharged, using one of the constant current methods of charging if possible.

Determination of State of Charge

No exact method exists for measuring the state of charge of a Nicad battery. However, the following techniques are reasonably accurate and will indicate the relative state of charge.

Method 1: (Most accurate.) Connect cells to a constant potential buss supplying 1.5 volts. After 5 minutes, connect an ammeter in series with batteries and buss. If current is less than 0.2 amperes, you may assume the cells are fully charged.

Method 2: (Least accurate.) Measure cell voltage. A fully charged cell should produce about 1.3 volts; a fully discharged cell should produce about 1.15 volts.

Periodic Checks and Maintenance

After cells have been in continuous service for 3 months, equalize, clean, adjust electrolyte level and charge as described previously. If electrolyte level was low, try to determine the cause of this condition. If no evidence of leakage is present, low level is probably due to excessive gassing and resulted from charging at high currents. Generally, white deposits *in* the vent wells (potassium carbonate) indicate loose vent plugs or excessive gassing and may be considered normal. White deposits *outside* the vent wells indicate that electrolyte has escaped the vent wells. The point here is simply this: if elctrolyte has been lost, *electrolyte* should be used to bring level back to normal. If level is low due to gassing only, add *distilled* water, as the chemicals were not lost and addition of electrolyte will result in excessive electrolyte strength.

You may now test the capacity of the cells by discharging at a 4 ampere rate and observing voltage drop over a one hour period. After one hour, voltage should be at least 1 volt. Any cell which does not pass this test is defective, or possibly does not contain sufficient potassium hydroxide. You may attempt to salvage cells by adding an aditional ½" of *electrolyte*, equalizing, charging and testing again. A cell which fails the test three times is not up to par.

It is also important to allow cells to rest for 48 hours between charging and testing; failure to observe this rest period will not damage cells, but will introduce errors into the results of dischage tests.

Following tests, charge cells and return to service, or place in storage.

Storage

These cells may be stored in *any* state of charge, and at temperatures ranging from minus 55 degrees C. to plus 75 degrees C Self-discharge will occur at the rate of approximately 10% of the initial charge per wee at temperatures below 50 deg. C., and will occur much more rapidly above this temperatur Cells which have been in storage for longe than 2 months should be equalized, inspecte and charged before being returned to servic

When cells are to be stored for long period of time, all metal parts should be coated wit vaseline or light grease, and the vent plug should be tight.

Conclusion

Uses of these cells are countless. I have built at least a dozen gadgets using transistors since my purchase of the cells,and have found them to be the most convenient source of voltage levels I have owned. So, adventuresome souls, dash out and buy a few of these gadgets and tak advantage of another "fringe benefit" of th space age.

. . . W4VGS/1

The ARB Aircraft Receiver

getting it operational

Gordon Hopper W1MEG
75 Kendall Ave.
Framingham, Mass.

The ARB receiver is a superhet capable of AM, CW and RTTY reception in the range of 195 and 9050 kcs. Actually, its performance probably leaves something better to be desired, but it is capable of being a secondary receiver in a ham station.

The easiest way to power the receiver would be to supply 28 VDC to pins 1 and 2 (ground) on J102 (*power*), thereby utilizing the dynamotor furnished with the receiver. Rewiring the filaments for 12 VAC operation will create problems (without major conversion) as there are 28 VDC relays in the circuit. (If the dynamotor is not to be used, then supply 225 VDC to pins 35 and 36 (ground) on J103 (*accessories*) and 28 VDC to pins 1 and 2 (ground) on J102.) Attach the right angle fitting and tuning knob to the fitting beside the tuning dial window.

INTERCONNECTING CABLE

FROM P-101	TO P-201 (or P-301)
1	1
2	2
3	3
4	4
5	5
6	6
7	7
12	12
13	13
14	14
15	15
16	16

Actually it is necessary only to furnish 28 VDC to the receiver, to attach the tuning knob to the receiver, and to make up a simple cable to utilize the remote CW switch and volume control that is contained in the remote head.

Select the pilot's control box (shown in the TM on page 85) and make up one cable to connect the control box to the receiver (J201 *control box*). The cable is a reduced version of W401 on page 113 in the TM. Keep the cable simple. Do the band switching manually at the receiver and thereby reduce the current requirements of the 28 VDC supply. The control box will be used to turn the 28 VDC on or off, to select the mode of reception, to select MVC or AVC, and to control the receivers gain.

. . . W1MEG

VLF • LF • MF

OPTIMIZED SOLID STATE RECEIVERS

MODEL VLRC-1

MODEL VLRB-1

10 to 40 KC • 30 to 600 KC
CONTINUOUS TUNED COVERAGE

IN TODAY'S ERA OF ATOMIC WEAPONS, FREQUENCIES AT THE LOWER PORTION OF THE RF SPECTRUM (BELOW 600 KCS) ARE LEAST AFFECTED BY ATOMIC DETONATION AND ARE THEREFORE VERY IMPORTANT FOR COMMUNICATION PURPOSES. THESE FREQUENCIES ARE ALSO PROVEN TO BE A VERY RELIABLE RADIO COMMUNICATIONS MEDIA DURING PERIODS OF HIGH SUNSPOT ACTIVITY.

FOR VLRC-1
REQUEST
TB 3017

- CW, FSK, FAX, AM, AME
- 0.3 MICROVOLT FOR 15db $\frac{S+N}{N}$
- RF, IF and AUDIO OUTPUTS
- VARIABLE SELECTIVITY
- PERMEABILITY TUNING
- AVAILABLE SYNTHESIZED OR UNSYNTHESIZED

FOR VLRB-1
REQUEST
TB 3015

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Adding SSB to the ARR-7

George Marshall W6BHR
554 Westborne Drive
Los Angeles, Cal. 90048

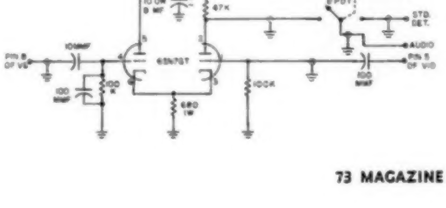
I bought an ARR-7 from R. E. Goodheart after trying in vain to find anything with that complete coverage and overall quality at anywhere near the price. Although Goodheart had already removed and bypassed the reradiation suppressor, this article on adding SSB will be written for those who have an unmodified receiver. For those already possessing one of these versatile sets, or for those contemplating purchase, the ARR-7 is an extremely simple receiver in which to install a product detector.

Proceeding directly to the heart of the matter, the following steps make it possible to modify the receiver in a few hours' time. First, remove and discard the 6AB7 which precedes the first of the two rf amplifiers. This tube was used only as a reradiation supressor so don't worry about losing gain or sensitivity in discarding it. The socket is utilized in the modification and the tube is replaced by a 6SN7 Product Detector.

The front-panel screws are loosened sufficiently to get an end wrench between the front panel and the chassis in order to remove the spst bfo switch. When the nut on the switch has been considerably loosened, the switch may be rotated about, so that with a gun-type iron, or other iron with a small tip, the connections may be removed from the terminals.

Replace the old switch with a DPDT and reconnect the wires removed from the old switch in such fashion that they are switched ON in the bfo "ON" position. Use the uppermost terminals, the ones closest to the top of the receiver, for these connections, the single wire going to the center terminal and the pair of wires going to the other terminal.

Returning to the vicinity of the 6AB7 socket, there is a terminal board immediately adjacent, on which are mounted °79, C80, R54 and R55. Clip off, or unsolder these components so the terminal board can be re-used. Be careful when removing R-55, as this 47K resistor can be re-used as the plate load for the 6SN7. The B lead in the lower corner should also be carefully unsoldered, then the entire board can be removed for ease in installing the new components which consist of a .1 mf capacitor, a 10K ½ w resistor, and the re-installed 47K resistor. The terminal board is modified as follows: Remove the ground connection which runs in the vertical plane and swing it around to the B lug.



While the terminal board is out of the way, the octal socket may be rewired for the 6SN7 as follows: Remove the antenna lead from pin 4 and the lead connected to pin 8. These two leads may now be directly connected by placing them on the unused lug of the terminal board when it is replaced. The jumper going from pin 3 to pin 5 is removed, carefully, from pin 5 and connected to pin 6. If carefully removed, the ground lead connected to pins 1 and 2 can also be reused. A "soldering aid" tool is an asset for this sort of operation. A piece of spaghetti is slipped over this ground lead and it is then connected to pin 8 which takes care of the heater circuit. The other components are now connected to the socket, the 100K resistor from pin 1 to pin 8, the 100K resistor with a 100 pf capacitor across it, from pin 4 to pin 8 and a 680 ohm 1 w resistor from pin 6 to pin 8. (This is the only 1 w resistor; all others are ½ w.) The terminal board can now be reinserted.

When placing the .1 mf capacitor on the terminal board, leave enough lead on the B end and it can be used to connect directly to pin 5 on the octal socket.

Remove the 3 screws from the bfo compartment and remove the cover. Inside you will notice a "gimmick," two wires twisted together; remove these and replace them with a 100 pf capacitor. Remove the lead going from the lug to the 6H6 for bfo injection. Remove the #6-32 machine screw and place a ground lug under this screw and replace the screw. Replace the cover on the bfo.

Prepare a 7" piece of small coax or shielded lead as follows: Strip one end so that about ½" of shield is exposed and about ¾" of center conductor and its insulation. Strip off about ¼" of this insulation exposing the center conductor. This end of the shield will be connected to the ground lug installed on the bfo compartment and the center conductor connected to the lug which formerly went to 6H6. The other end of the center conductor is connected to pin 1 of the tube socket. The 47K resistor from the terminal board can now be connected to pin 2 of the socket.

An 8½" piece of small coax is stripped in the same manner as the previous piece. With a hot iron, a place can be puddled and tinned with solder on the vertical wall of the bfo compartment nearest to pin 8 of the last *if* tube. The shield of the coax is grounded at this point and the exposed center conductor is connected through a 10 pf capacitor to pin 8 of the last *if* tube. The center conductor at the other end is connected to pin 4 of the 6SN7.

Now, on the opposite side of the receiver there is a long terminal board. On it, near the rear of the receiver, is the audio coupling capacitor C77; the lead nearest you is removed and transferred to a blank lug which is toward the rear of the receiver.

Now strip 2 26" pieces of small coax exposing the shield and center conductor at both ends. Strip another 26" piece so that the shield and center conductor is exposed only on one end. This end will be connected to the DPDT switch at the front panel. All three shielded leads can be snaked up through the harness along the right side of the receiver when looking at the bottom of the eceiver, which will tend to keep things neat.

The center conductor of the coax which is stripped on only one end is connected to pin 2 of the 6SN7. The center conductor at the other end is connected to the lug of the unused section of the DPDT bfo switch is closest to the center of the receiver. The center conductor of the next coax is connected to the center lug of the switch and the other end of the center conductor is connected to C77. The third coax center conductor is connected to the remaining lug on the switch, and thence connected to the point that C77 was removed from.

The 3 shields at the point near the switch are wrapped with bare wire and soldered together. The other end of the two leads going to the audio can be tacked together in similar fashion. Where the lead which goes to the Product Detector, goes by the bfo compartment, about ½" of shield should be exposed and connected to the same point as the lead which went to the last *if* (the solder puddle at the side wall of the bfo compartment).

With all leads now installed on the 6SN7 socket, room can be found to connect the 10 mf decoupling capacitor to the ground lug of the adjacent tube. This completes the modification; plug in a 6SN7, hook up the power and start product detecting whenever the bfo is on. This modification does not affect ordinary CW reception, but makes it easy to tune and receive SSB signals. Either side band can be selected by adjustment of the bfo knob. It works like a charm!

. . . W6BHR

Leroy May W5AJG
9428 Hobart St.
Dallas 18, Texas

Photo credit: Jim Dungan, Dallas

The ARC Type TV-10 and 10A

Converting them to 220 mc transverters

The surplus unit designed ARC Type TV-10 or TV-10A Transmitter-Converter, commonly known as a Transverter, is built by the Aircraft Radio Corporation and is known generally as ARC Type 12 equipment, or ARC Type 220 UHF Portable Communicator equipment. In the military, it is also designated as a Frequency Converter-Transmitter CV-431/AR.

As used in this instance, a transverter performs in one unit the functions of a transmitter and receiving converter. The transmitter is of course on the desired frequency on which one wishes to send, while the receiving converter translates this frequency to an existing receiver of another frequency.

For instance, these equipments normally transmit on a fixed frequency or frequencies between 228-258 mc, and transforms or converts the reply in this same frequency range, to a new rage of 118-148 mc, so as to enable existing receiving equipment to be used. In ham talk, this is a crystal-controlled transmitter combined with a crystal-controlled converter, contained in one case.

Our interest here is to convert the unit to something usable in the 220-225 mc ham range by utilizing the crystal-controlled transmitter and converting the received 220 mc signal to the 144-148 mc range, so as to make use of the existing 2 meter receiver in the station.

There is a little difference between the Model TV-10 and the Model TV-10A. The former has a rated transmitter output of one-half watt, while the latter is rated at a nominal two-watts output. The receiving converter section is identical in both units.

With a few modifications, this little unit will enable one to operate low-power on 220 mc, without installing a separate 220 mc receiver. It is very light in weight and may be worked in a mobile capacity if desired. Although low in power output, several uses suggest themselves—such as CD nets, RACES tie in—and so on.

Modifications

The amateur 1¼ meter band is a rather wide one and different parts of the frequency range are used in different localities. In an effort to split the difference, a design frequency of 225.5 mc was chosen, which represents the midpoint of the assignment.

Transmitter: A schematic diagram of the original TV-10 unit is reproduced and may, for all practical purposes, be used for the Model TV-10A also. The first order of business is the tube heaters. This equipment is designed for 27v dc operation and if either 12v or 6.3v is desired instead, some changes must be made in this wiring. This is rather routine and inspection of the schematic and the actual

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5. Full 143.8 MC to 148.2 MC coverage with calibrated tuning dial
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8. NUVISTOR RF stage and low noise first mixer provide .2 μv sensitivity (10 db S + N to N)
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6CW4	Rcvr RF	12AX7	AF Amplifier
6KE8	Mixer/Xmtr Osc	6BQ5	Rcvr Audio Output/ Xmtr Modulator (2)
6KE8	VLO/Buffer		
6BA7	2nd Mixer	6EA8	Xmtr XLO/1st Multiplier
6AZ8	IF Amplifier		
6BA6	IF Amplifier	12BY7	Buffer Amplifier
6AL5	Diode Detector/ Noise Limiter	12BY7	Xmtr Driver
		2E26	Xmtr Final Amplifier

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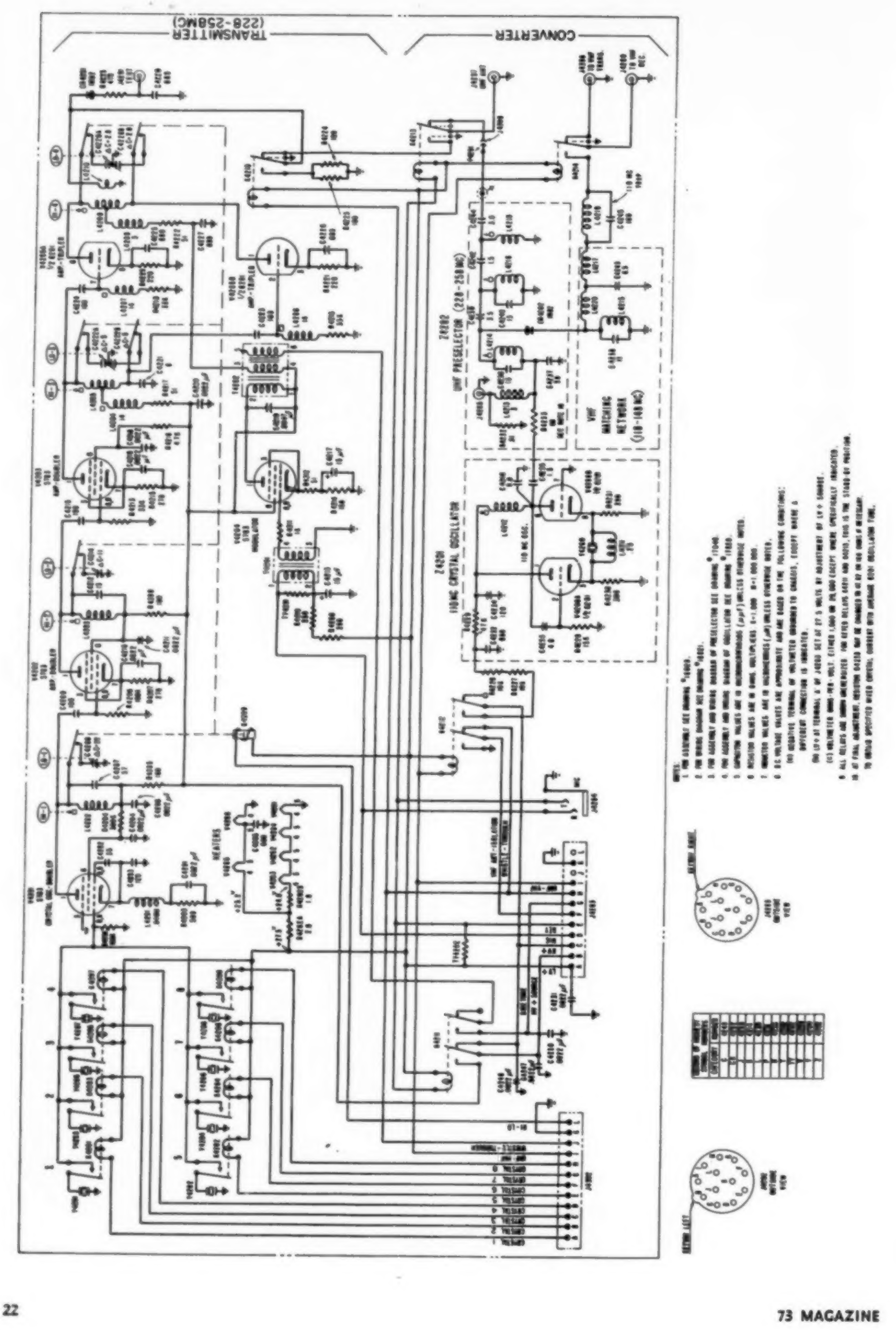
TRANSMITTER (228-258MC)
CONVERTER
Z4202 UHF PRESELECTOR (228-258MC)
Z4201 110MC CRYSTAL OSCILLATOR
VHF MATCHING NETWORK (118-148MC)
HEATERS
NOTES:

unit will suggest the best way for your case. Of course, the simple way out would be to continue to use the 27v dc. This is not as difficult as it once was—what with all the silicon devices around able to handle a couple of amperes without sweat. If it is desired to use ac however, the mike line will have to be disconnnected and rerouted to some source of mike current.

Relays: The next items to be considered are the relays. These are also 24 V dc operated and of course ac will not work here. Fortunately, all of the relays will not be used. Most will remain in the circuit but in their normal unenergized position, and in which case, one side of the coil may be disconnected to keep them from operating. A couple will be used in their energized position. This may be accomplished by blocking the armature closed with a tooth-pick or other suitable means, along with disabling the coil by the disconnect procedure as on the others. Actually, the only relay that would be of value would be the antenna change-over relay. If it is desired to retain this one, it will be necessary to provide 24v dc to operate it. Following is the relay schedule:

Disconnect one or both sides of the coils of every relay in the set, causing them to be disabled, with the exception of the antenna change-over relay K4213. Block in a closed position the two relays marked K4211 and K4214. Further details on some of the individual relays will be given shortly.

Power Supplies necessary: As above mentioned, if 24v dc is available and can be used, much work will be eliminated. Without the relays, about ¾ a will do the job. If 12 volts are used, 1.5 a will be necessary and if 6.3v is used, about 3a will have to be provided. The plates will require 250-275v dc at about 130 mills for the ½ watt output.

On the power receptacle J 4203, the filament heater voltage will go to terminal "A" marked LV+. The B+ will go to terminal "B". The microphone transformer primary T4201 will have to be isolated and fed to the mike being used. Terminal "E" will key the antenna relay by grounding same. When the transmitter is in stand-by position and B+ is not being fed to terminal "B", it will be necessary to get voltage to the receiving converter. This could be accomplished by connecting a wire from the bottom of R4227 to an unused terminal on J4203, such as "L", and feeding the converter voltage at that terminal when receiving and to terminal "B" when transmitting—or perhaps some other arrangement will suggest itself that would fit in better with individual

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existing available power supply facilities or switching.

Circuitry: The original frequency range of the transmitting crystals used to cover the 228-258 mc segment was between 9.5-10.75 mc when using a multiplication of 24 times. An alternate multiplication of 36 times could also be used in the gear and in that case the crystal frequencies would be between 6.333 and 7.166 mc. Either arrangement was permissible and satisfactory.

To provide the newly desired output frequency of 222.5 mc a crystal of either 9270.8 kc or 6181.481 kc will be necessary. The latter frequency rock was available at this station and was a surplus one of the type that was used in the old SCR-522 two-meter equipment. Using either crystal, however, no alterations in the rf circuitry are necessary. Merely retune the coils and/or capacitors for maximum rf output at Test Jack J4201 on front of the unit. A small range mill-meter may be used here for the best indication. Also a lamp load could be used for testing and for the tune-up. Select one of the crystal socket positions, insert the 6181.481 kc crystal and block closed the associated relay. The other crystal sockets and relays will not be used.

The 220 mc antenna will connect to J4207 labelled UHF ANT. J4208 labelled to VHF TRANS will not be used. J4209 labelled to VHF REC will be used to go to the 144 mc station receiving equipment. This is the output of the converter section of the TV-10 after the signal has been translated from 220 mc to 144 mc.

Receiving Converter Section: Refer again to the schematic. Note that Z-4201 is an 110 mc crystal oscillator. This 110 mc crystal is actually a *7th overtone type*, with inductor L-4212 resonating on the output frequency of 110 mc. Now since the fundamental of this overtone crystal is one-seventh of 110 mc, or about 15.7 mc, we can change the mode over to the *5th overtone*, which will be approximately 15.7 x 5 = 78.5 mc. Coil L-4212 will have to be padded to resonate at this new frequency. This is accomplished by merely removing capacitor C-4248 (9 mmfd) and replacing with a disc or tubular of 25 mmfd. The coil will now resonate on 78.5 mc and the new *if* frequency will be the difference of 222.5 – 78.5 = 144 mc, which will work into a 144 mc receiving system very nicely. One other change in the receiving converter section is necessary and that is to change the 110 mc trap circuit labelled L-4219 and C-4245 to the new frequency of 78.5 mc. This is simple to do—merely bridge C-4245 with another capacitor of 150 mmfd. Lastly, after a 222.5 mc signal is received, touch up the slugs on the Preselector Z-4202 section for maximum signal. These slugs would be L-4218, L-4216 and L-4214 labelled "Factory Adjusted—Do Not Disturb." (Haven't you always been tempted to do something like this anyway?). This should complete the modifications.

Remember, the converter is a mixer with no rf amplifier stage. It should work well for the stronger signals—do not expect too much on very weak signal reception. Add a nuvistor, or perhaps a 416B 220 mc preamplifier for such work. Also keep in mind that the transmitter output stage on the TV-10 is a tripler with multiplied crystal ferquencies probably present to some extent. This is low power certainly, but aircraft line of sight is great and this range of frequencies is hot with such communications. Check carefully with a GDO or sensitive absorption type instruments for such unwanted emissions.

This little set will enable someone mildly interested in 220 mc to talk around town locally and it might even whet the interest to give 220 mc a real shake at some later date.

. . . W5AJG

Notes on the ARR-15 Receiver

Gordon Hopper W1MEG

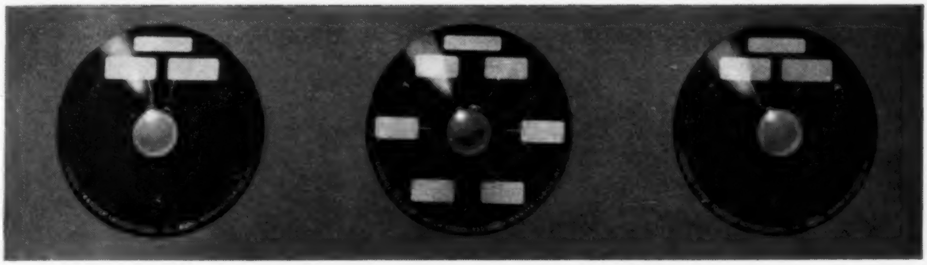
The ARR-15 receiver, as received, will function by the addition of the correct voltages and actually requires no major conversion work.

Application of 28 VDC to the connector at the rear of the receiver will operate the dynamotor and it should be applied as follows:

Pins 3 and 20	jumpered
Pin 17	28 VDC
Pin 9	dc return

John Meshna, Inc. in Lynn, Mass., has power supplies which are ideal for the operation of this receiver. They are rated at 24 volts @ 4 amps and can be used on many types of surplus receivers.

In its original condition, the receiver is quite broad. Here is a modification which will select either a sharp or a broad filter: Remove the wire from terminal 2 of Z-122 and tape it out of the way. Remove the ground post.



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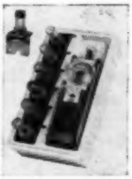

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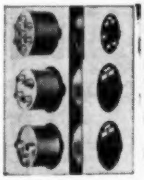

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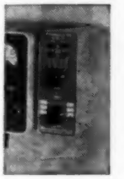

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WATERS — WAYLAND MASS

Install a SPST bat handle switch in the vacated hole. Run a wire from terminal 6 of J-102 to one switch terminal and run a wire from the other switch terminal to terminal 2 of Z-122.

To make the receiver active when the receiver is off "0" when in MCW-CAL position, remove the wire from terminal 7 of J-102 and install SPST bat handle switch between this wire and terminal. Switch can be located below switch in above modification and labeled CAL. OFF-ON.

To make it possible to calibrate on frequencies whose last two digits are "0," jumper terminals 14 and 22 of J-110.

The addition of a Q5R may be desirable. Although I have the receiver operational, I have not yet had the chance to try one on it.

If desired, an AC supply for the B voltage (220 VDC at 80 ma) can be connected between pins 3 and 9 (ground) of the dynamotor connector after removing the dynamotor.

To reduce the current requirements of the 28 VDC power supply, it is recommended that the two locks on the front panel be loosened and that the tuning and band switching be accomplished manually.

The original technical manual for the ARR-15 receiver is identified as AN-30ARR15-3. Good luck on locating one.

New Life for the R-44/ARR-5 Receiver

Ronald L. Ives
2075 Harvard St.
Palo Alto, Calif.

Introduction

Many amateurs and experimenters have purchased surplus R44/ARR-5 receivers in the belief that they were military versions of the Hallicrafters S-27. After finding out that the receiver has no power supply, lacks sensitivity, and has headset output only, they have stored the rather well-built equipment in the garage, and have gone on to other things.

Actually, the R44/ARR-5 *is* a military version of the well-known S-27, and can be made to operate as an S-27 with a very small amount of work. Basically, it is an AM-FM receiver, with one rf, oscillator, mixer, and two rf stages. Beyond this, there is a limiter and discriminator for FM reception; and an added *if* stage and diode detector for AM reception. Two stages of audio are provided.

Frequency coverage, in three ranges, is from 27 mc to 140 mc. A motor-driven band-scanning device is provided, as well as a fixed tuned bfo. Broad and sharp *if* adjustments are selectable by a front panel switch.

This frequency range covers 10 and 6 meters, a number of radio paging services, the lower frequency TV channels, all of the FM band, and the 110-140 mc aeronautical and

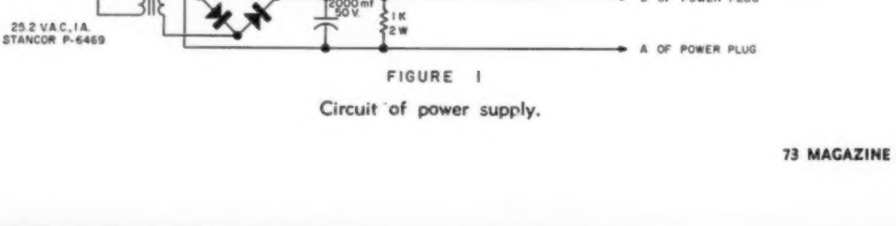
270-0-270 V., 200 Ma
STANCOR P-8172
2 A
117 V.A.C.
.02
600 V
6 - M-500's
L1 FROM RECEIVER
THORDARSON 20C55
6 Hy, 200 Ma
80 mf
450 V
MALLORY FP-149's
80 mf
450 V
+270 VOLTS
100 K
2 W
F OF POWER PLUG
C OF POWER PLUG
E OF POWER PLUG
B OF POWER PLUG
6.3 V.A.C., 8.5 A.
4 - M-500's
MOTOR SUPPLY
2000 mf
50 V.
1 K
2 W
D OF POWER PLUG
A OF POWER PLUG
25.2 V.A.C., 1 A.
STANCOR P-6469
POWER PLUG
B+
FIL.
F A E B D C
+ MOTOR CIRCUIT

FIGURE 1

Circuit of power supply.

special communications bands. As a general coverage receiver from 28-140 mc it can hardly be surpassed, even though the design is more than 20 years old. It can be put into full service by providing a power supply and by making a few very simple circuit changes.

Power Supply

Operation of the R44/ARR-5 requires 6.3 volts at about 4 amps; 270 volts at about 135 ma; and, if the motor driven scanner is to be used, 24 volts dc at about 135 ma.

The circuit of a more than adequate power supply for this receiver is shown in Fig. 1. Choke input is used here to keep the B voltage low enough. It also reduces surges on the silicon rectifiers. The first choke (L1 from receiver) is an original part of the R44/ARR-5, and is located at extreme left rear of the chassis. Remove both power leads from this and connect them together temporarily, then remove the choke from the receiver.

The .02 mfd capacitor across the high voltage secondary is to absorb rectifier switching transients. If omitted, this power supply may create interference at various multiples of 60 cycles up to at least 60 kc.

Ordinarily good construction is all that is required in the power supply, which is conventional in operation. If you do not want to use the motor-driven scanner, omit the motor supply circuit entirely.

Initial Testing

Once the power supply is complete, connect the receiver in accord with the plug diagram in the inset of Fig. 1, turn it on, and let it warm up for a few minutes. Connect any sort of antenna to the antenna input plug, and plug a headset into the phones jack. Check operation of all functions on all bands, and correct any troubles found.

Most likely troubles are cracked resistors and switches that don't work. Replace resistors found defective by those of like color code. Replace any of the laminated bakelite switches that don't work by good switches, preferably with moulded bakelite cases, so that a second generation of switch failures doesn't develop in a couple of years.

Improving Sensitivity

When this receiver is in operation, its sensitivity is low, and the signal-to-noise ratio is not very happy. This difficulty is due to the installation of a radiation preventer stage between the antenna and the first tuned rf stage. This is located in a small annex to the main tunner housing, at left rear. The top of this box carries the label "CAUTION, plate termi-

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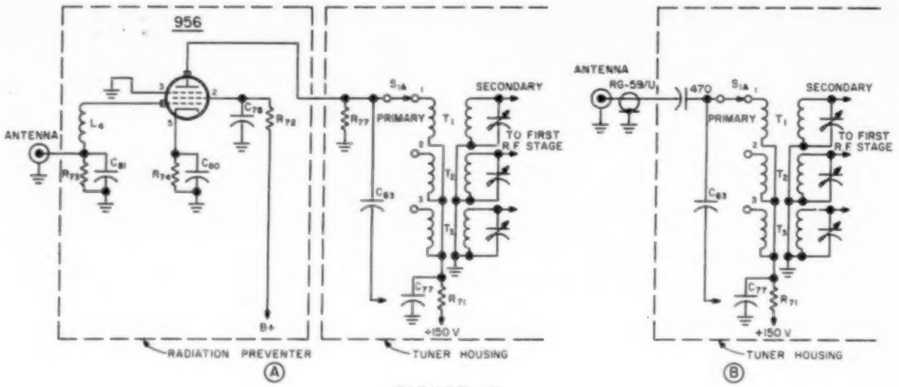

FIGURE 2

Front end revisions.

nal of tube inside projects into R-F stage." This stage is run at low B voltage so that it does not amplify, but unhappily it does contribute to the input noise.

The circuit of the front end of the R44/-ARR-5, as supplied, comprises section A of Fig. 2. To improve the receiver sensitivity, this stage is eliminated. Start by removing the 956 tube from the socket, then remove the small shield box, and finally disconnect the screen and filament supply leads from the connector that goes through the chassis. This will leave a clean circular hole in the back of the main tuner housing, and a clean elliptical hole through the chassis below it.

Remove R-77, a small resistor that connects from the plate lead of the 956 to ground. Center a UG-177/U plug hood over the round hole in the back of the tuner enclosure, mark the positions of the four holes, and drill clearance holes for 4-40 screws at the marked locations. Attach a piece of RG-59/U coaxial cable to the plug hood, leaving about 1½" of clear conductor on the inside. Bolt the plug hood in place, and mount two tie points on the holding screws inside the tuner shield. Connect the free end of the RG-59/U to the one farthest from the tunning capacitors. Connect a 470 mmfd capacitor between them, and connect the plate lead of the removed 956 to the tie point nearest the tuning capacitors. Pass the cable down through the elliptical hole in the chassis, and bring it out to either the front panel SO-239 plug marked ANTENNA or to any other termination that suits your convenience. Check operation, replace the cover on the tuner shield, and the front end changes are completed.

In most instances, this will more than double the usable sensitivity of the receiver, reducing the "front end hiss" considerably at the same time. Final circuit is shown in Fig. 2, B.

Output Modifications

As supplied to the government, the R44/-ARR-5 was designed for headphone and video output, and no provision was made for speaker operation. The original audio output circuit is shown in Fig. 3, A. All major components are mounted on terminal strips along the chassis skirts, and all are clearly numbered on the bakelite.

To convert the receiver for speaker operation, it is necessary to rip out the video output components and install an output transformer. To start this, cover the large hole at the left rear of the chassis (left when L1 was removed) with a metal plate, bolted in place. On the top of this, mount a small universal output transformer, such as a Stancor A-3877. Provide a grommet hole for the transformer leads. Under the chassis, behind the transformer, mount a tie point. To this connect the two leads removed from L1 previously, and the B+ lead of the output transformer. Connect the plate lead of the transformer to pin 3 of the 6V6 socket. Do not remove the other leads, or disturb the .33 meg resistor between pins 3 and 6 of this socket. This is the feedback resistor, R60 of Fig. 3.

Now find and remove R59, R70, R61, R69, R63 and C64. These are on the terminal strips near the tube socket, except for R63, which is a power resistor at about the middle of the terminal board. These components are best

(Turn to page 32)

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Another Surplus Find

Among the many thousands of items found on the surplus market, there is one unit that is often overlooked or rejected by the "surplus scavenger." This is the dynamotor set, not to be confused with the dynamotor alone.

The dynamotor set consists of a dynamotor, mounting bracket, chassis, various capacitors, a choke, filter assemblies, resistors, etc. The number and type of components will vary with each type of dynamotor set, but those components listed are generally common to all such sets. Taking the DY-76A/A1C-10 set as an example, the following components were removed and cataloged: one DY-76A dynamotor, (input 27.5 volts dc @ 7 amps, output 175 volts dc @ .6 amps), one filter reactor, (.2 henry @ .65 amps, tested at 1000 volts dc, resistance 7 ohms), two 100 mfd @ 300 wvdc electrolytics, two sealed pi type filters, (one rated at 50 volts dc @ 7.5 amps, and one at 250 volts dc @ 1 amp), and one 5½" x 7½" x 1½" chassis.

The 50 volt pi type filter may be used as an excellent filter for mobile operation of receivers, converters and low powered transmitters. The 250 volt filter may be used as an output filter for low voltage supplies or other such applications. The reactor, or choke, could easily find its way into power supplies, etc. Many applications can be found for the extremely well made, long lasting electrolytics. There is no need to mention the many uses of a strong aluminum chassis of the dimensions listed. In fact, the holes already punched in the chassis will serve most applications without the need of adding others. The holes punched for the mounting of the two electrolytics are perfect for tube sockets. Four permanently attached bolts hold the two chassis halves together quite neatly.

The 27.5 volt dynamotor can be operated from a 12 volt source with its output reduced approximately one half. It can also be operated from a 24 volt marine power source with no apparent decrease in output. If no such use is contemplated, the dynamotor can be converted into a 115 volt ac motor with little trouble and no expense.

The following instructions will enable the dynamotor to be used as an electric motor. First, remove the brushes from the motor end of the dynamotor assembly. The motor end is usually identified on the name plate, or can be found by tracing the yellow input lead. (The red lead is the positive high voltage output lead.) Remove the two field wires from the motor end and connect them in parallel with the generator field winding. Connect a 115 volt line cord across the field coils and generator brushes. If, after applying power, the motor does not run, reverse the motor field connections. There is a fifty-fifty chance of improperly connecting the motor field windings. As the dynamotor shafts are not long enough to attach a pully, etc., it will be necessary to drill and tap the shafts to attach an extension. The motor that you now have may not deliver as much torque as a standard, commercial motor, but it may be used in many applications. Its low cost more than overcomes any shortcomings it may have. One of these conversions is used by the author to power a small grinding wheel, and another is used to power a blower for cooling of electronic equipment.

The dynamotor sets are found at most surplus dealers and their low cost makes them one of the best buys on the surplus market. Better hurry and get yours before the price goes up!

Propagation Chart

EASTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7•	14	14	14	14
ARGENTINA	14	14	7•	7	7	7	14	14	14	14	21	21
AUSTRALIA	14	14•	14	7	7	7	7	7	7	7	14	14
CANAL ZONE	21	14	14	7	7	7	14	14	14	14	14	21
ENGLAND	14	7	7	7	7	14	14	14	14	14	14	14
HAWAII	14	14	14	7	7	7	7	7	14	14	14	14
INDIA	14	14	7	7	7	7•	14	14	14	14	14	14
JAPAN	14	14	14	7	7	7	7	7•	7	7	14	14
MEXICO	14	14	7•	7	7	7	14	14	14	14	14	14
PHILIPPINES	14	14	7•	7	7	7	7•	14	14	7•	7•	14
PUERTO RICO	14	14	7	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7	7	7	7	7	14	14	14	14	14	14	7
U. S. S. R.	14	7•	7	7	7	7•	14	14	14	14	14	14
WEST COAST	14	14	14	7	7	7	7	14	14	14	14	14

Good: 2-8, 14-17, 22-24

Fair: 1, 9-13, 22-21, 25, 28-30

Poor: 18-19, 26-27

Es: 4-8, 13-18

(High MUF and/or freak conditions)

CENTRAL UNITED STATES TO:

ALASKA	14	14	14	14	7	7	7	7•	14	14	14	14
ARGENTINA	14	14	14	7	7	7	14	14	14	14	14•	21
AUSTRALIA	14	14•	14	14	14	7	7	7	7	7	14	14
CANAL ZONE	21	14	14	14	7	7	14	14	14	14	14	21
ENGLAND	14	7	7	7	7	7	14	14	14	14	14	14
HAWAII	14	14	14	14	7	7	7	7	14	14	14	14
INDIA	14	14	14	7	7	7	7•	14	14	14	14	14
JAPAN	14	14	14	14	7	7	7	7•	7	7	14	14
MEXICO	14	14	7•	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	14	14	7	7	7	14	14	7•	7•	14
PUERTO RICO	14•	14	14	7	7	7	14	14	14	14	14	14•
SOUTH AFRICA	7	7	7	7	7	7	14	14	14	14	14	7
U. S. S. R.	14	7•	7	7	7	7	7•	14	14	14	14	14

J. H. Nelson

WESTERN UNITED STATES TO:

ALASKA	14	14	14	14	7	7	7	7	7•	14	14	14
ARGENTINA	14	14	14	7•	7	7	7	14	14	14	14	21
AUSTRALIA	14•	21	21	14	14	7•	7	7	7	7	14	14
CANAL ZONE	14•	14	14	14	7•	7	7	14	14	14	14	14
ENGLAND	14	7	7	7	7	7	7	14	14	14	14	14
HAWAII	14	14	14•	14	14	7•	7	7	14	14	14	14
INDIA	14	14	14	14	7	7	7	7•	14	14	14	14
JAPAN	14	14	14	14	14	7	7	7	7•	7•	14	14
MEXICO	14	14	14	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	14	14	14	7	7	7	14	7•	7•	14
PUERTO RICO	14	14•	14	7	7	7	7•	14	14	14	14	14
SOUTH AFRICA	7	7	7	7	7	7	7•	14	14	14	14	7
U. S. S. R.	14	14	14	7•	7	7	7	7•	7•	14	14	14
EAST COAST	14	14	14	7	7	7	7	14	14	14	14	14

* Means next higher frequency may be useful. . .

(Receiver from page 28)

removed by clipping the leads. Because of their age, few of them are worth salvaging.

Now, from pin 5 (grid) of the 6V6 to ground connect a .1 meg resistor, of ½ watt or larger. From pin 8 of the same tube (cathode) connect a 330-ohm 2 watt resistor to ground, and shunt it with a 25 mfd, 25 volt electrolytic capacitor, connected with positive to socket.

Lastly, connect the secondary circuit of the output transformer to the speaker terminals and the phone jack, as in Fig. 3, B. With this connection, the speaker is silent when the headset is plugged in. The load that is switched in when the speaker is disconnected is not critical, any value from 5 to 22 ohms will work well, but its omission will insure that the audio circuit will oscillate powerfully.

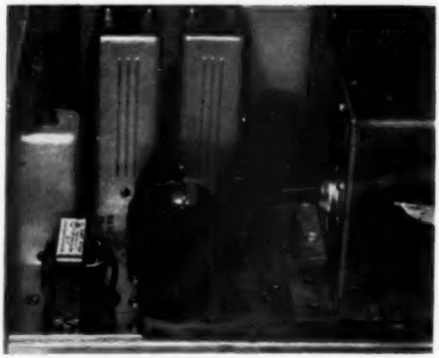
When this work is completed and tested, the conversion of the receiver to ordinary use is completed. Appearance of the left rear portion of the chassis, where the changes have been made, is shown in the photo. If, after everything tests OK, you wish to go over the underchassis wiring, eliminating unnecessary wires and sections of terminal board, appearance of the equipment will be improved slightly, but no changes will occur in the performance.

Automatic Scanning

As previously mentioned, this receiver is equipped with an automatic scanning device, which requires an input of 24 volts dc. The range of the scan is adjustable from the front panel, by means of a pair of switch cams under the hinged cover. The on-off switch for the automatic scan is near top center of the panel. The speed of the scan is adjustable by means of a 250 ohm wirewound rheostat at rear center of chassis. This runs quite hot on continuous scan, as does the motor. The magnetic clutch, which connects the motor drive to the tuning shaft is a rugged device, which will last almost forever. The motor, in contrast, has a nominal life of about 1,000 hours, of which a considerable portion may have been used up in military service.

ACTION REQUIRED

Please send a letter or radiogram to your Representative in Congress asking that he expedite the "International Reciprocity for Radio Amateurs" bill (S.920). This is of immediate importance, do not delay.



Rear chassis view of converted R44/ARR-5.

Performance of this receiver, after conversion, is rather surprisingly good and as consistent as band conditions permit. Tuning gear train operates very smoothly, permitting use of the receiver on the sometimes crowded 10 and 6 meter ham bands. The power supply has enough spare capacity to carry most if not all of the adjuncts that a fertile mind will find interesting with this type of receiver.

. . . Ives

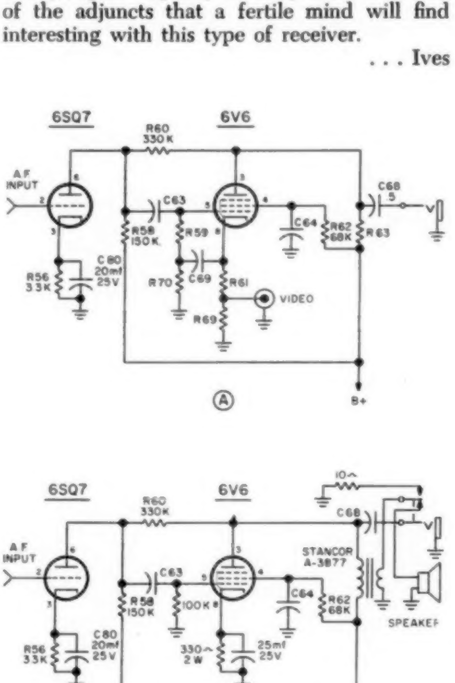


FIGURE 3

Receiver output circuit.

Really High Gain

Jim Kyle K5JKX
1236 N.E. 44th St.
Oklahoma City, Okla.

Gain in an audio amplifier is something you seldom worry about unless you don't have enough—but if you're planning a new portable or mobile rig, you might like either of the two circuits shown here. Both produce voltage gains in excess of 1,000, with an absolute minimum of components.

Using these circuits, a ceramic or dynamic microphone will give you plenty of punch for full modulation—without the worries about audio quality which frequently accompany the use of a carbon mike.

The lead-off circuit, shown in Fig. 1, is a variant on the cascode. The cascode is probably better known as a VHF rf amplifier than as a high-gain audio circuit—but this version gives voltage gain ranging from 1,000 to 2,000, depending on the type of tube used.

Since three triode sections are necessary for best action, this circuit is a natural for Compactrons such as the 6D10 or 6C10. Component values shown are suitable for either, as well as for the three halves of 12AX7, 12AT7, or 12AU7.

Here's how it works. In a normal cascode circuit, the stage gain is actually (very close to) the product of the transconductance of the *input* section multiplied by the load impedance seen by the *output* section. In this version, the load impedance is 4.7 megohms. To keep current flow in the input stage, thus keeping transconductance high, the output stage is shunted by a 22K ohm resistor.

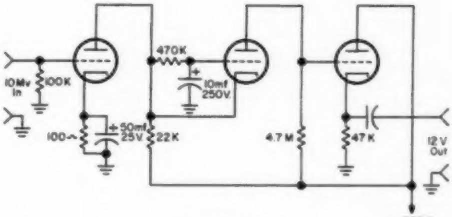


FIGURE 1

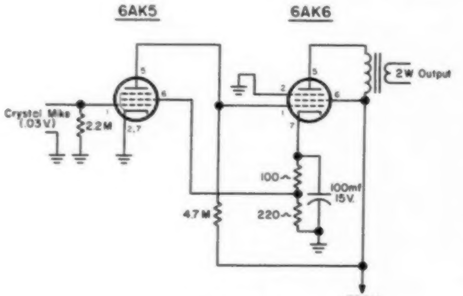


FIGURE 2

Since the input impedance of the output stage is low (usually under 500 ohms), all the signal goes into the output stage. Thus, the stage gain equals the transconductance of the normally functioning input stage times the extremely high plate load resistance in the "output", giving a range of gain between 1,000 and 2,000.

The cathode follower actually used as the output is necessary because otherwise the high output impedance would cause problems above 1500 cps. As shown, response is good throughout the "communication" range up past 3,000 cps, then falls off rather sharply.

The only tricky point to watch in this circuit is to be certain that no heater wires or rf-carrying leads come anywhere near the plate end of the 4.7-meg resistor or the lead connected to the grid of the cathode follower.

While the three triode sections connected as normal amplifiers would provide more actual gain, such connections would also require 3 additional resistors and 3 additional capacitors, as well as introducing phase shifts and attendant possibilities of audio feedback.

But if you're searching for something closer to the ultimate in the "something-for-nothing" department, sneak a peek at Fig. 2. This "starved" amplifier uses only two tubes, four resistors, a single capacitor, and one transformer, to fully modulate a 5 watt transmitter with the output of a ceramic mike!

(Turn to page 90)

Smaltz for Semiconductors

Robert A. Kidder

After about the forty-seventh time that I put the finishing touches on some exotic piece of semiconductorized gear and reached out to apply the juice, only to find that another battery pack had gone to its reward, I finally decided to end it all. Not with the trusty old .44, however, but by hitting the books and engaging in a bit of judicious brain-picking among certain of my cohorts. Herewith follows the results of this research: a treatise on the derivation of low voltage direct current in any reasonable quantity from the ac line.

The biggest difference between vacuum tube plate supplies and transistor supplies is impedance. Tube circuits in general are high impedance affairs and are therefore low current loads. Transistors, on the other hand, are inherently low impedance devices and are heavy loads for power supplies. A typical tube circuit might draw 15 milliamps at 150 volts, or 2.25 volt-amperes, while a similar circuit in transistors might require 15 milliamps at 15 volts, which is also 2.25 volt-amperes. This makes the transistor supply a big, hairy monster, when considered on the basis of the voltage to current ratio. This means that the transistor supply must have very low impedances associated with it. Its output impedance especially must be as low as possible. With this much having been stated, let us now have at these semiconductor feed-bags.

The first thing to consider is the rectifier, because this will have a direct bearing on virtually every other component in the supply. Figure 1 shows a simple, inexpensive, half-wave circuit, which is suitable for light loads (25 milliamps or less). The main reason that heavier current drains from this circuit are not advisable is that the half-wave rectifier is quite inefficient. It delivers to the load less than 50% of the available current. Another point to consider is that the 60 cycle ripple in the output of a half-wave rectifier is five times harder to filter than the 120 cycle full-wave buzz. This means that hum will increase at a much faster rate with an increasing load than it would in the case of a full-wave circuit. A factor stemming from this is that voltage regulation is inherently poor in a half-wave supply. These faults notwithstanding, half-wave circuitry can be used in compact, low current supplies, especially if very small ripple is not a requirement.

Figure 2 illustrates two basic types of full-wave rectifiers. 2A is the conventional center-tapped configuration which is commonly used in vacuum tube plate supplies. In transistor supplies, however, this circuit is not employed as extensively as in Figure 2B, the full-wave bridge. The full-wave center-tap circuit can be used for loads of any magnitude, but it delivers only about 70% of the available current, and it requires a transformer with a center-tapped secondary. Digging up a center-tapped transformer that will produce 35 to 40 volts of dc could be quite a sporting proposition.

Since suitable rectifiers can be had at very reasonable prices, the full-wave bridge of Figure 2B offers distinct advantages. One is the fact that it will pass 90% of the available current, which makes it the most efficient of the rectifiers under discussion. In transistor power supplies, it is by far the most commonly used rectifier circuit.

The characteristics of each type of rectifier should be kept in mind when choosing components. A diode being used in a half-wave circuit should have a current rating of at least twice the maximum anticipated load current, and a peak inverse voltage rating equal to 2.8 times the RNS voltage of the transformer secondary (this PIV rating criterion assumes the use of a capacitor-input filter, which is the usual case in transistor supplies). Rectifying elements in a center-tap circuit should have a current rating at least equal to the load current, and the PIV of each diode will be 1.4 times the RMS voltage of the transformer's entire secondary. The minimum current rating for each of the four diodes in a full-wave bridge is equal to one half of the maximum anticipated load current, while the minimum PIV rating is the same as for a center-tap circuit.

Usually the power transformer for a transistor supply is a small filament transformer. These are available in quite a number of secondary voltages, ranging from 2.5 to 26.5 volts, with higher voltages obtainable in other types of power transformers. Other kinds of transformers, such as audio output or interstage types, can be used also, especially in low current supplies, but the word here is "Caution".

(Turn to page 38)

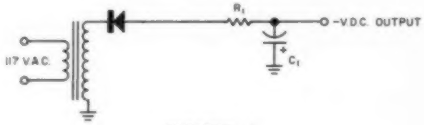

117 V.A.C.
R1
-V.D.C. OUTPUT
C1

FIGURE 1

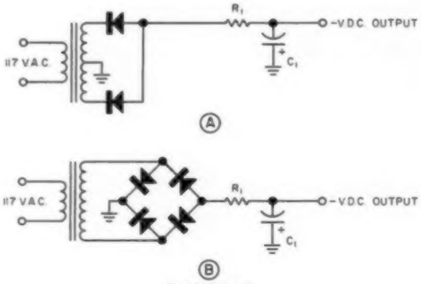

117 V.A.C.
R1
-V.D.C. OUTPUT
C1
A
117 V.A.C.
R1
-V.D.C. OUTPUT
C1
B

FIGURE 2

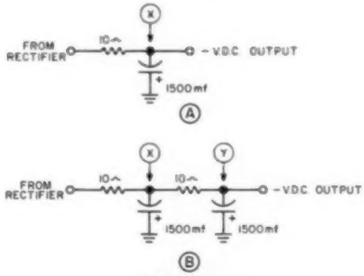

X
FROM RECTIFIER
10Ω
-V.D.C. OUTPUT
1500mf
A
X
Y
FROM RECTIFIER
10Ω
10Ω
-VDC OUTPUT
1500mf
1500mf
B

FIGURE 3

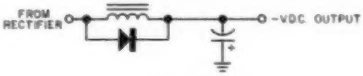

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FIGURE 4

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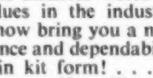
(400 cps) 1 lb. $19.95
Export model available for 115/230 volts AC, 50-60 cps; write for details.

SB-300 SPECIFICATIONS—Frequency range (megacycles): 3.5 to 4.0, 7.0 to 7.5, 14.0 to 14.5, 21.0 to 21.5, 28.0 to 28.5, 28.5 to 29.0, 29.0 to 29.5, 29.5 to 30. **Intermediate frequency:** 3.395 megacycles. **Frequency stability:** Less than 100 cps per hour after 20 min. warmup under normal ambient conditions. Less than 100 cps for ±10% line voltage variation. **Visual dial accuracy:** Within 200 cps on all bands. **Electrical dial accuracy:** Within 400 cps on all bands after calibration at nearest 100 kc point. **Backlash:** No more than 50 cps. **Sensitivity:** Less than 1 microvolt for 15 db signal plus noise-to-noise ratio for SSB operation. **Modes of operation:** Switch selected: LSB, USB, CW, AM. **Selectivity:** SSB: 2.1 kc at 6 db down, 5.0 kc at 60 db down (crystal filter supplied). AM: 3.75 kc at 6 db down, 10 kc at 60 db down (crystal filter available as accessory). CW: 400 cps at 6 db down, 2.5 kc at 60 db down (crystal filter available as accessory). **Spurious response:** image and IF rejection better than 50 db. Internal spurious signals below equivalent antenna input of 1 microvolt. **Audio response:** SSB: 350 to 2450 cps nominal at 6 db. AM: 200 to 3500 cps nominal at 6 db. CW: 800 to 1200 cps nominal at 6 db. **Audio output impedance:** Unbalanced nominal 8 ohm speaker and high impedance headphone. **Audio output power:** 1 watt with less than 8% distortion. **Antenna input impedance:** 50 ohms nominal. **Muting:** Open external ground at Mute socket. **Crystal calibrator:** 100 kc crystal. **Front panel controls:** Main tuning dial; function switch; mode switch; AGC switch; band switch; AF gain control; RF gain control; preselector; phone jack. **Rear apron connections:** Accessory power plug; HF antenna; VHF #1 antenna; VHF #2 antenna; mute; spare; anti-trip; 500 ohm; 8 ohm speaker; line cord socket; heterodyne oscillator output; LMO output; BFO output; VHF converter switch. **Tube complement:** (1) 6BZ6 RF amplifier; (1) 6AU6 Heterodyne mixer; (1) 6AB4 Heterodyne oscillator; (1) 6AU6 LM osc.; (1) 6AU6 LMO mixer; (2) 6BA6 IF amplifier; (1) 6AU6 Crystal calibrator; (1) 6HF8 1st audio, audio output; (1) 6AS11 Product Detector, BFO, BFO Amplifier. **Power supply:** Transformer operated with silicon diode rectifiers. **Power requirements:** 120 volts AC, 50/60 cps, 50 watts. **Dimensions:** 14⅞" W x 6⅝" H x 13⅞" D. **Net weight:** 17 lbs.



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Export model available for 115/230 volts AC, 50-60 cps; write for details.

SB-400 SPECIFICATIONS—Emission: SSB (upper or lower sideband) and CW. **Power input:** 170 watts CW, 180 watts P.E.P. SSB. **Power output:** 100 watts (80-15 meters), 80 watts (10 meters). **Output impedance:** 50 to 75 ohm—less than 2:1 SWR. **Frequency range:** (mc) 3.5-4.0; 7.0-7.5; 14.0-14.5; 21.0-21.5; 28.0-28.5; 28.5-29.0; 29.0-29.5; 29.5-30.0. **Frequency stability:** Less than 100 cps per hr. after 20 min. warmup under normal ambient conditions. Less than 100 cps for ± 10% line voltage variation. **Carrier suppression:** 55 db below peak output. **Unwanted sideband suppression:** 55 db @ 1 kc. **Intermodulation distortion:** 30 db below peak output (two-tone test). **Keying characteristics:** Break-in CW provided by operating VOX from a keyed tone (Grid block keying). **CW sidetone:** 1000 cps. **ALC characteristics:** 10 db or greater @ 0.2 ma final grid current. **Noise level:** 40 db below rated carrier. **Visual dial accuracy:** Within 200 cps (all bands). **Electrical dial accuracy:** Within 400 cps on all bands after calibration at nearest 100 kc point. **Backlash:** Less than 50 cps. **Oscillator feed-through/mixer products:** 55 db below rated output (except 3910 kc crossover which is 45 db). **Harmonic radiation:** 35 db below rated output. **Audio input:** High impedance microphone or phone patch. **Audio frequency response:** 350 to 2450 cps ±3 db. **Power requirements:** 80 watts STBY, 260 watts key down @ 120 V AC line. **Dimensions:** 14⅞" W x 6⅝" H x 13⅜" D.

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(Semiconductors from page 35)

In picking a transformer, you should keep in mind that the input capacitor of the filter will charge up to the peak voltage of the secondary. The peak voltage is equal to 1.4 times the RMS voltage at which the secondary is rated. Thus, a 6.3 volt filament transformer will develop nearly nine volts across the filter capacitor, which, if it is large enough, will maintain that voltage level even in the teeth of a moderately heavy load.

Another factor to consider in choosing a transformer is the rectifying circuit that it will be looking into, because this will affect the current rating of the secondary. The efficiency figures given previously for the various types of rectifier circuits refer to the percentage of a transformer's secondary current capability which can be drawn by the load without overworking the transformer. They are less an indication of how big a wagon a supply is than of how big a horse the transformer has to be in order to move it. If a half-wave rectifier is to be used, the current rating of the secondary should be equal to at least twice the maximum expected load current. In the case of a center-tap circuit, the secondary current capability should exceed the load current by at least 40%. For a full-wave bridge, the current rating of the secondary should at least equal the heaviest anticipated load current.

Now let's take a look at filter circuits. The first component usually encountered is the surge limiting resistor, R1, which is added to protect the rectifier. The reason for this is that when the supply is first turned on, the uncharged filter capacitor is a dead short, and the instantaneous current flow is very high. Without R1 in the circuit, this surge would be limited only by the forward resistance of the rectifier in series with the resistance of the wire in the transformer secondary. The peak surge current could be 20 amps or more, which is enough to wipe out instantly many low current diodes. The value of R1 is picked to keep the maximum possible current flow (effectively the same as a short from the rectifier output to ground with the peak secondary voltage present) less than the one-cycle surge rating of the rectifying element. Typical values for R1 will fall between 5 ohms and 50 ohms, in general. The surge limiting resistor is not always required with medium to heavy duty rectifiers (those rated at 500 milliamps or higher). A quick look at the Condensed Rectifier Specifications sheet in the fourth edition of the G. E. Transistor Manual seems to indicate that the one-cycle surge rating of any given (G. E.) rectifier is at least 20 times greater than its continuous current rating.

The next component is the filter capacitor. For most light and medium load applications, the B. F. C. (Brute Force Capacitance) approach is usually adequate. This consists of hunting up the biggest, hairiest, electrolytic capacitor you can find and placing it across the output of the supply, such as with C1 in Figures 1 and 2. In general, 250 microfarads should be considered the practicable minimum for loads up to 20 or 25 milliamps. Where loads approach one amp, the filter capacitor may have a value of five thousand microfarads or more, although with loads of this magnitude it's better practice to use a multi-section filter and electronic regulation.

The voltage rating of the filter capacitor should be taken into account, too. It goes without saying that an electrolytic must never be exposed to voltages greater than its rated working level, nor should they be wired up in reverse polarity. They've been known to come apart with explosive force under either condition. The voltage rating of an electrolytic should always exceed the actual voltage present in its working circuit by a small margin, at least 20%, but it can go as high as 100% or more. In any event, if the voltage rating is greater than the working voltage by a large amount, three or four times, for instance, the capacitor may not "form" properly. This condition manifests itself as a loss of rated capacitance, and as a result, the filtering action can be reduced greatly. In choosing a filter capacitor, then, keep its voltage rating higher than, but reasonably close to, the peak voltage of the transformer secondary.

In a previous paragraph, multi-section filters were mentioned. Let us examine them more closely forthwith. Referring now to Figure 3A, suppose the load is such that there is 100 millivolts of ripple at point "X". Assume further that this amount of ripple is intolerable for the desired application, but that 10 millivolts would be acceptable. In order to reduce the hum voltage by a factor of ten, several things can be done. You could increase the value of C1 ten times. Fifteen thousand microfarad electrolytics are available, and they're well within the means of the average working millionaire. A more practicable, and certainly less expensive, solution is to add a second filter section, as in Figure 3B. Since the reactance of a 1500 microfarad capacitor is slightly less than one ohm at 120 CPS (assuming full-wave rectification), the 100 millivolts of ripple present at point "X" will see an effective resistance of 11 ohms to ground: the ten ohms of R2 in series with the one ohm reactance of C2. This is a simple voltage divider. Therefore, the ripple to be found at point "Y" will be 1/11 of the ripple at point "X", or just over 9 millivolts, with the remaining ninety-odd millivolts having been dropped across R2. The DC voltage at point "X" will see only R2 in series with the load resistance, with C2 looking like an open circuit. Ripple could be further reduced by increasing the value of R2, but watch out for the DC voltage drop across it. With a one amp load on the circuit of Figure 3B, the DC drop across R2 would be 10 volts. The writer hastens to add that the values given for R1 and R2 in Figure 3 are obviously not advisable in normal practice for a one amp filter circuit.

Chokes are not usually used as filter elements in semiconductor supplies. One of the reasons for this is the fact that the DC resistance is fairly high, as much as two or three hundred ohms. Another reason is that most of the small filament transformers commonly used in transistor supplies can deliver one amp without even trying; if you happen to have a one amp choke lying about, it could be used to far better advantage in your kilowatt vitamin pill. Still other factors to consider are large physical size, magnetic radiation, and dangerously high (for transistors) inductive kickback voltage when the supply is turned off.

It is not the writer's intention to condemn the use of chokes in semiconductor supplies, however. They can be utilized, sometimes to good advantage, for loads up to a quarter amp or so, if the overall size of the supply is not a factor. The first consideration is that the choke will tend to hold the output voltage at the RMS voltage of the transformer secondary, thereby affording improved regulation. The choke should be positioned with its core at right angles to the transformer core in order to minimize hum radiation, although this is a lesser problem with semiconductor devices than with vacuum tubes, owing to the inherently low impedances of transistors. The inductive kickback can be neutralized by connecting a diode across the choke, as shown in Figure 4. The polarity of the diode should be such that it does not conduct when the supply is in use; it acts to short out the high voltage spike generated by the collapsing magnetic field of the inductor when the supply is turned off, or otherwise suddenly interrupted. One other thing: make sure the capacitor and choke combination that you use is not resonant at either 60 or 120 cps, otherwise you may find that you have raw, wild ac of startling amplitude instead of clean, smooth dc. If you do decide to use a choke, put it ahead of the filter capacitor and omit the surge limiting resistor.

This half of the article has detailed the process of converting the ac line power to low voltage dc which may be used "as is" for many transistor circuits. In the second half we shall examine various ways to regulate the output voltage of these supplies. We'll also look into methods of varying the voltage output. Be sure to tune in again next month.

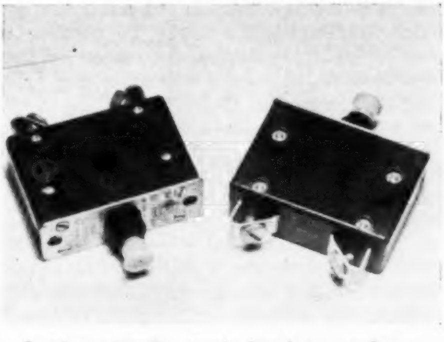
. . .Kidder

Surplus Circuit Breakers

Roy Pafenberg W4WKM

Large quanities of aircraft circuit breakers are available on the surplus market in a wide range of current values. Typical of those available are the 10 ampere units shown in the photograph. Since the prices are so ridiculously low, you have probably passed them up as unusable for ac and low-voltage dc applications. Such is not the case. These low-cost breakers are usable in most amateur applications.

Before we go into specific applications, a description of the most commonly available units is in order. These breakers, shown in the photograph, measure approximately ¾″ wide by 2 3/16″ high and extend about 2″ behind the panel. Mounting is accomplished by two 6-32 screws on 1 13/16″ centers. A clearance hole of ½″ diameter is required for the actua-



Surplus aircraft circuit breakers, such as these 10 ampere units, have wide amateur application.

tor knob bushing. Terminals consist of metal tabs equipped with 8-32 machine screws. The breaker is closed by pushing in on the front button and opened by pulling it out. In the event the breaker trips, reset is accomplished by simply closing the breaker again.

These breakers are of the thermal trip type so that trip is a function of both percentage and duration of overload. While these units are specifically rated at 120 volts, 400 cycle ac and 30 volts dc, they may be (and have been) successfully used at 120 volts, 60 cycle ac. Current ratings of the standard types range from 5 to 50 amperes and low amperage units are available in the range of 1 to 4 amperes.

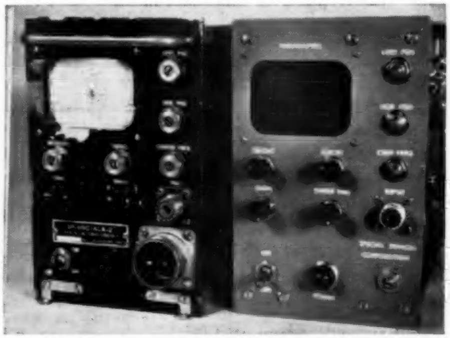
These surplus thermal-trip circuit breakers will carry 100% of their rated current indefinitely and will trip at 125% of their rated current. Trip time at 200% overload ranges, for the various types, from 8 to 25 seconds. Trip time for greater overloads is proportionally shorter. Current interruption capacity varies with voltage and frequency but, in any event, is on the order of several thousand amperes.

Designed to meet military specification requirements, these breakers are *relatively* immune to vibration, shock and temperature variation. Give these low cost, high quality breakers a try in your next construction project. They provide a simple answer to mobile and home station power switching and protection requirements.

. . . W4WKM

Converting the IP-69/ALA-2 Panoramic Indicator

William Parker W8DMR
2738 Floribunda Drive
Columbus 9, Ohio



Unit as purchased left, and after conversion right. The power connector hole was plugged with an aluminum disk and liquid aluminum paste.

The budget-restricted ham can convert the surplus ALA-2 into a satisfactory panadaptor. Before diving into the conversion, it is best, especially if one does not have understanding of the operation of a panadaptor, to review the functional operation of such a unit. (See block diagram, Fig. 2.) Briefly, the panadaptor is an electronic device that displays on the face of a cathode-ray tube a portion of the radio frequency spectrum. Individual vertical "pips" are panoramically displayed across the horizontal axis of the CRT face. See Fig. 1. An incoming signal (from a receiver) is fed into the broad-band rf amplifier, than into a mixer, the *if* amplifier, and the detector, just as in any conventional superheterodyne receiver. However, the local oscillator voltage supplied to the mixer must vary sufficiently in *frequency* so that it can cover the frequency width carried by the rf amplifier. This is accomplished by the reactance tube which varies the oscillator frequency over the proper range. The reactance tube is controlled in turn by the sawtooth generator so that the frequency variation of the oscillator is kept in synchronism with the horizontal deflection. As this deflection occurs, the oscillator beats progressively and periodically with one signal after another to produce an intermediate frequency of 6.5 megacycles. Thus one signal after another is periodically amplified by the *if* amplifiers which are resonant to 6.5 megacycles. Each signal as a signal of the intermediate frequency, in its own order is subsequently rectified by the detector.

The output of the detector is fed to the vertical amplifier and the output of the latter is fed to the vertical deflection plates of the cathode-ray tube.

A signal voltage from the vertical and horizontal amplifiers is used to excite the blanking and intensifier circuit. The output of this circuit is connected to the control grid of the cathode-ray tube and accomplishes two things.

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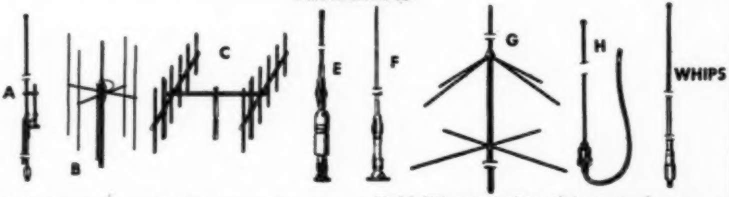

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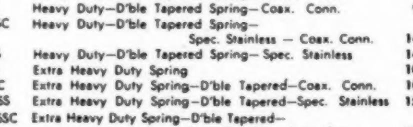

BASE MOUNT	DESCRIPTION	NET
232	D'ble Tapered Spring—Swivel Base	8.75
232C	D'ble Tapered Spring—Swivel Base Coax. Conn.	8.75
232SS	D'ble Tapered Spring—Spec. Stainless	12.95
232SSC	D'ble Tapered Spring—Spec. Stainless — Coax. Conn.	12.95
232X	Heavy Duty—D'ble Tapered Spring—Swivel Base	9.85
232XC	Heavy Duty—D'ble Tapered Spring—Coax. Conn.	9.85
232XSSC	Heavy Duty—D'ble Tapered Spring—Spec. Stainless — Coax. Conn.	14.95
232XSS	Heavy Duty—D'ble Tapered Spring—Spec. Stainless	14.95
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232XXC	Extra Heavy Duty Spring—D'ble Tapered—Coax. Conn.	10.85
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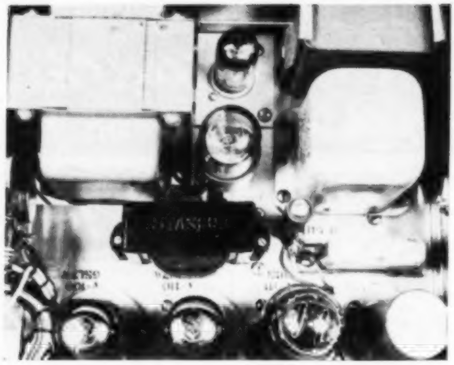


It blanks out the retrace and intensifies the trace whenever a signal deflection takes place.

Conversion Details

The panadaptor power supply is designed for 380-1000 cycles. It will be necessary to replace the power transformer with a 60 cycle oscilloscope power transformer. The one used by the author was a replacement transformer for a Heath 0-11 oscilloscope. See modified schematic diagram. Most transformers do not provide for a 1B3 filament winding. The transformer used in this conversion used a IV3 high voltage rectifier. The author also wished to remove the power connector, name tag, fuse holder, handle and mounting fasteners from the front panel to give the unit a commercial appearance.

Each individual will have ideas that suit his own needs or that utilizes a particular "junk box" part that he wishes to make use of in the conversion of the panadaptor. The steps outlined in the article will serve as a guide to help get started.

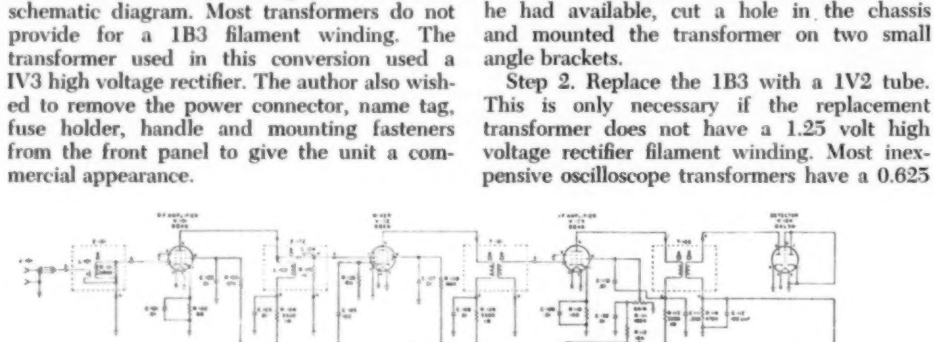
A brief reason will be given for the part that was changed or replaced to help in the understanding of the conversion. This will be particularly helpful in the advent of trouble and also help you to determine if the change is unnecessary or fits your particular application.

The unit that was converted by the author was very clearly marked with respect to component identification. Reference to a resistor for example, R125, upon inspection of the unit, is very easy to locate. Hallicrafters did an admirable job when they built this unit for the Air Force.

Conversion Steps

Step 1. Replace power transformer with 60 cycle version. Remove 400 cycle transformer. See schematic diagram for transformer details. The author, in order to mount the transformer he had available, cut a hole in the chassis and mounted the transformer on two small angle brackets.

Step 2. Replace the 1B3 with a 1V2 tube. This is only necessary if the replacement transformer does not have a 1.25 volt high voltage rectifier filament winding. Most inexpensive oscilloscope transformers have a 0.625



filament winding, and will only operate a IV2 satisfactorily.

Step 3. Replace the following resistors in the high voltage power supply section and accompanying voltage divider circuit. (Note: Throughout the conversion, many of the resistors removed may be used again in the conversion. Therefore treat the leads with respect.) In order to provide the 800 to 1000 volts needed for the high voltage with the ripple component low enough, and still use the high voltage filter capacitors C124A and C124B, it is necessary to:

1. Increase the value of R147 from 22K to 220K 1 watt.
2. Increase the value of the high-voltage divider network to limit the current drain.

Remove R159 220K 1 w. Replace with 1.0 meg 1 watt. Remove R147 22K 1 w. Replace with 220 K (use R159). Remove 156 150K 1w. Replace with 680 K 1 watt. Remove yellow wire from R155. Add in series a 22K 1 watt (use R147) between yellow wire and connection of Intensity control. Remove R160 56K ½ w. Replace with 150K (use R156). This improves the astigmatism of the electron beam.

Step 4. In the author's unit, it was found necessary to add a small 8 henry–70 to 100 milliamp choke in series with B-plus. In addi-

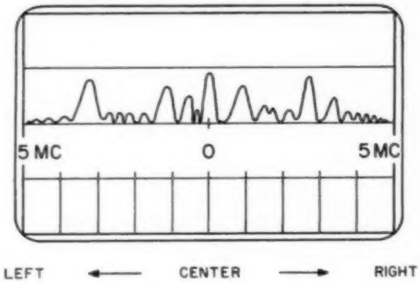

5 MC
0
5MC
LEFT
CENTER
RIGHT

FIGURE I

Block diagram less power supply.

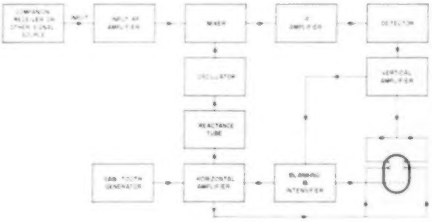

COMPANION RECEIVER OR OTHER SIGNAL SOURCE
INPUT
INPUT RF AMPLIFIER
MIXER
IF AMPLIFIER
DETECTOR
OSCILLATOR
VERTICAL AMPLIFIER
REACTANCE TUBE
SAW TOOTH GENERATOR
HORIZONTAL AMPLIFIER
BLANKING & INTENSIFIER

FIGURE 2

Typical display on screen of panadaptor.

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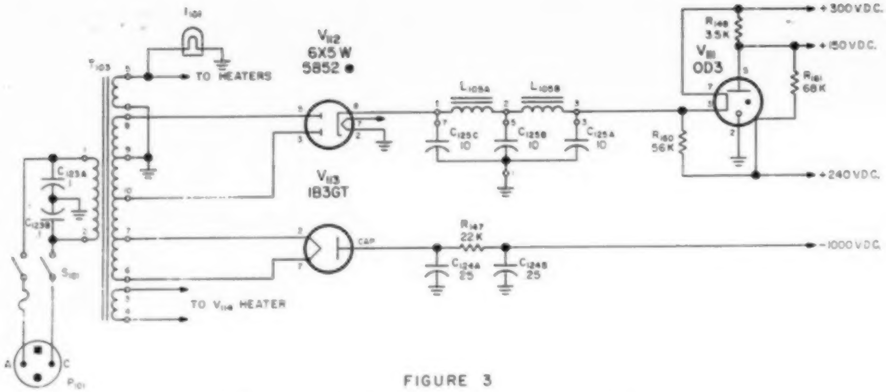
I101
V112
6X5W
5852 ●
T103
TO HEATERS
V113
1B3GT
CAP
L105A
L105B
C125C
10
C125B
10
C125A
10
R147
22K
C124A
25
C124B
25
C123A
1
C123B
1
S101
TO V114 HEATER
A
C
P101
R148
3.5K
V111
OD3
R161
68K
R160
56K
+300 VDC.
+150 VDC.
+240 VDC.
−1000 VDC.

FIGURE 3

Power supply before any changes are made.

tion, B-plus was found to be 350 volts, and needed to be reduced. As opposed to using a series-dropping resistor, choke input to the filter section was chosen. See sketch for this arrangement.

Step 5. The sawtooth generator frequency was original 35 cps. This does not lend itself to 60 cycle operation, because of the beat of the 60 and 120 cycle power supply ripple. Locking of the 884 sawtooth generator to the 60 cycle power line was chosen. The other components in this circuit were changed to improve linearity, amplitude and wave shape. Stability was improved by returning R125 to plus 150 also. It may be necessary to vary R125 from the value used in this article. Capacitor C121 was found to have leakage (0.1 mfd. 400 v) and was producing drift in the horizontal axis.

Connect a 2.2 K ½ watt resistor from pin 5 to pin 7 of the 884 sawtooth generator, v 107, This locks the oscillator to line frequency. Remove C120 0.1 mfd. Replace with 0.2 mfd. 400 volts. Remove C122 .01 mfd. Replace with 0.1 mfd. (use C120). Added care must be exercised in the next several changes if no errors are to occur. Remove R125 180K 1 watt (a 43K resistor eventually). Remove jumper form top of R113 to top of post where R125 was just removed. A small mirror used to view under the terminal strip will show a red wire (the wire is B-plus that supplies the 310 volt to R113, R109, and R104). Heat the terminal from top side of the terminal board, using a pic to pull the red wire loose from the underside of the terminal board. If necessary, lengthen the red wire so it now may be connected to the top of R113 and R109. Connect a jumper from the top of R121 (next to R109) to the top of the post where R125 used to be. Connect a 43K 1 watt resistor where R125 used to be. Remove R126 1.5 meg ½ watt. Replace with 1.0 meg ½ watt.

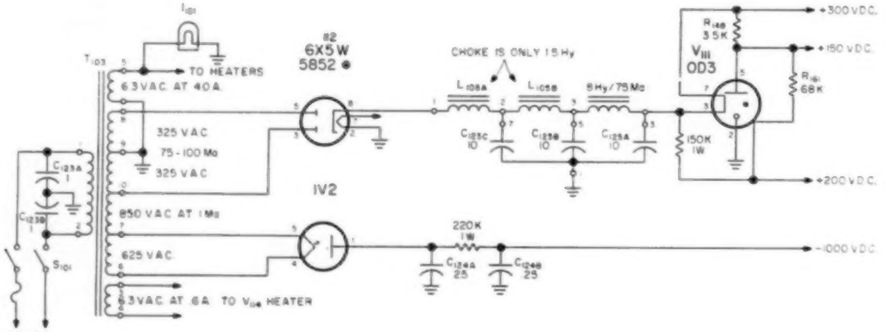
I101
112
6X5W
5852 ●
T103
TO HEATERS
6.3 VAC AT 4.0 A
325 VAC
75-100 Ma
325 VAC
850 VAC AT 1 Ma
625 VAC
6.3 VAC AT .6A TO V114 HEATER
IV2
CHOKE IS ONLY 1.5 Hy
L105A
L105B
8 Hy/75 Ma
C125C
10
C125B
10
C125A
10
220K
1W
C124A
25
C124B
25
C123A
1
C123B
1
S101
117 VAC
R148
3.5K
V111
OD3
R161
68K
150K
1W
+300 VDC.
+150 VDC.
+200 VDC.
−1000 VDC.

FIGURE 4

Power supply after changes are made. Note T-103 has been replaced with 60 cycle unit (see text).

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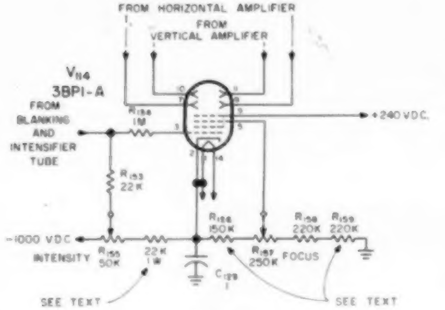

FIGURE 5

Only three resistor changes are required to high voltage divider network.

Step 6. Depending on just what vintage of ALA-2 that you have, you will note some production runs have the fuse holder on the front panel, some have fuse holders mounted inside the unit. The unit described in this article had internal fuse holder clips. They were removed, a fuse holder installed in the rear of the unit, and the ac power cord inserted through a grommet just below the fuse holder. The case was then modified to allow the fuse holder and the power cord with molded plug to freely allow casing and uncasing.

Step 7. Having made the necessary preliminary conversion steps, it is advisable to see if the unit will operate on 60 cycles satisfactorily. The *intensity* should control the brightness of the trace; the *focus* should be able to focus the trace. The *vertical* and *horizontal* controls should be able to position the trace. Before attempting any additional changes, the beam must be operating correctly. Observe if the VR-150 is glowing. Next measure the plus 300 volts dc. Measure the plus 150 volts dc. Do not proceed until these voltages are correct. Carefully measure the CRT high voltage. This should be approximately a negative 850 to 1100 volts. If the high voltage is accidentally shorted to ground, the 1V2 rectifier tube will most probably be permanently damaged. With a low voltage B-plus of 300 volts, the measured current was found to be 75 ma.

Step 8. To test the rf section, connect or couple either an rf signal generator or a grid-dip meter to the *input* connector. Set the *gain*, *sweep limit*, and *sweep width* controls full clockwise position. As the signal generator is tuned from 25 to 35 mcs, a "pip" should roll across the face of CRT. It may be necessary to reduce the level of the signal to keep the pip on the face of the CRT. Set the signal generator to 30 mcs and adjust the *center freq.* control to position the pip to the center of the screen. If this can be accomplished, then the unit is operating as it was intended to operate.

Applications

To display the VHF or UHF ham bands, a narrow-band panadaptor that is very adequate on the lower frequencies (below 10 meters) will not be adequate for a band like 420-450 mcs. Once the user realizes that the need to tune back-and-forth across several megacycles of VHF-UHF band is no longer necessary, the broad-band panadaptor soon becomes a valued piece of equipment to the ham shack.

After a CQ is called, one merely looks at the display on the panadaptor sees a "pip" rise on the screen, and tunes to that frequency to find out if that station is returning to his "CQ."

Often "CQ's" are missed because they are not observed soon enough. While reading the the mail, one may monitor the rest of the band, ready to take action when a station "appears."

This unit is used with broad band converters having an *if* range of either 26 to 30mcs or 30 to 34mcs. It could be modified for VHF converters with different *if* ranges. A check of the entire band may be made any time, because the signal fed to the panadaptor is from the broad-band crystal controlled VHF-UHF converter. In the case of panadaptors used normally for low frequency operation, the signal is fed to the panadaptor from the *if* output of the receiver and only about 250 kc can be observed. As the receiver is tuned, the signals roll by. Only those signals tuned in the pass-band can be observed.

. . . W8DMR

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see page 24 for article on this rig.

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Using the Telechrome 1462-A1 on 220

Leroy May W5AJG
9428 Hobart St.
Dallas 18, Texas

Photo credit: Jim Dungan, Dallas

The Telechrome Model 1462-A1 transmitter is a minature unit capable of supplying at least 50 watts of rf power into a 50 ohm load, over the telemetry frequency range from 215 mc to 235 mc. The modulation is FM/FM and the deviation sensitivity is such that a 2 volt peak voltage will produce a swing of ±125 kc. The transmitter is self-contained, except for the necessary power supply. A filter box, including filters for each power input lead, is included to minimize rf leakage from the input power leads.

The model 1462-A1 is readily adaptable to standard rack-panel mounting and an opening in the unit admits power, cooling air and the modulating signals, with an air seal to prevent air leakage.

Although this unit is capable of FM modulation as is, the application at this station was to be an AM driver for a final using a 4X150A tube as a class "C" modulated amplifier. In such service as this, a total of only 10 or 15 watts rf output were required. However, should one use this little box as a complete AM phone transmitter in itself, with an output of 50 watts rf, on 220 mc, a modulator of about 75 watts audio would be necessary.

The circuit contains a frequency modulated crystal oscillator operating at 1/6 the output frequency, and originally used crystals in the range from 35.53 to 39.17 mc. In order to cover the 220-225 mc band then, the crystal used would have to be between 36.6 and 37.5 mc, and the FM generating portion of the circuitry would be disabled or eliminated, so that the output from the 1462-A1 would be AM instead of FM.

Since crystals of this range are rather hard to come by, except by hard cash, an alternative arrangement was rigged up in the form of a crystal oscillator-tripler box, mounted external to the 1462-A1, and working into it with a short lead. This scheme will allow the use of common 8 mc rocks, the necessary actual frequencies being 8148 kc to 8333 kc, to cover the band. Also this new crystal oscillator will be much more stable than the original FM crystal circuit of 36 mc. Should FM be desired at a later date, the unit may easily be put back to its original state.

Power requirements for the full 50 watts of 220 mc rf output will require a plate supply of 500v dc at 300 ma for the final tubes, which are a couple of 2C39A's, and a supply of 300v dc at 100 ma will be necessary for the exciter stages. 6.3v ac at 3.5 amps will be required for the heaters of all the tubes.

Modifications

Refer to the photograph of the unit. The external minibox can be seen mounted to the right of the 1462-A1 transmitter. Closer inspection will show the crystal-tripler excitation lead into the main box from the minibox. Now refer to the two schematics. An original unmodified schematic is shown in Fig. 1. In Fig. 2, are shown the modifications to be performed.

The rundown on the original schematic shows V-101 as a modulator-driver. This tube is not used and may be removed. V-102 was originally the crystal oscillator-tripler. This tube will remain a tripler, but the crystal oscillator function will be performed by the external box oscillator-tripler just described. The diode modulator associated with this stage is disconnected and/or removed. V-103 was originally a doubler. Its operation will become that of a tripler, and no changes are necessary to do this. V-104 and V-105 will remain as is—buffer and driver—as well as the final two tubes, V-107, V-108, performing the function of a straight through amplifier.

In the modification then, we will have the following line up;

> New tube 6BH6 as an 8 mc crystal stage (actually 8155 kc for operation on 220.185—the desired frequency)
> New tube 5763 as a tripler to 24.46 mc. The above two tubes to be contained in the external minibox.
> V-102 as a tripler from 24.46 to 73.35 mc.
> V-103 as a tripler from 73.35 to 220.185 mc.
> V-104, 105, 106, 107 and V-108, as original with no changes.

The multiplication is now 27 times, instead of the original 6 times.

The 8 mc crystal oscillator plate supply is derived from dropping resistors in the common 300 volt line and this is further stabilized by a couple of OB2 gas regulators in series, as shown. The 5763 tripler plate coil, which is to be resonant at 24.46 mc, is a slug-tuned unit, one-half inch in diameter, close wound with 16 turns of no. 20 enamelled wire. A short lead of two-inches is then brought out of the minibox and a hole is drilled in the 1462-A1 adjacent to the original crystal socket. This provides coupling between the two units. Pin jacks are used here.

Rearrange the circuitry of the former crystal oscillator-tripler stage V-102, as per Fig. 2, and insert the 24.46 mc excitation from the minibox into the hot pin of the crystal socket of V-102. The plate coil of this stage, formerly resonant from 106 to 117 mc, is now padded with a 12 mmfd fixed high-quality capacitor to make the coil resonant at 73.35 mc. From this point on, throughout the rest of the transmitter, everything is normal and unchanged. All coils may be grid-dipped to their respective frequencies and peaked for maximum after the unit is fired up. A small blower will be necessary to cool the 2C39A's when running maximum power. This may be conveniently mounted behind the rack panel.

Operation

Using a watt meter rated good at 220 mc on the output of the transmitter, all tuning

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300-D	144-148	50-54	$12.95 ppd.
300-E	144-145	.6-1.6	$12.95 ppd.
300-F	144-146	28-30	$12.95 ppd.
300-G	14.0-14.35	1.0-1.35	$10.95 ppd.
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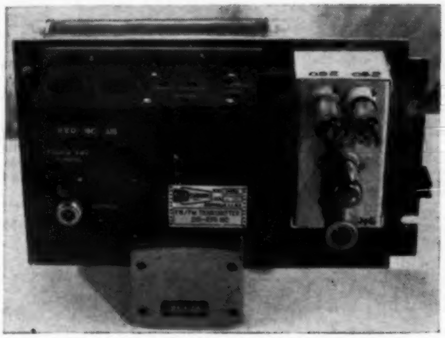

Front Panel View of the Telechrome 1462-A1 Transmitter.
Minibox at the right of the transmitter contains the 8 Mc xtal stage and the 24 Mc tripler stage. Voltage regulator tubes at top of box.
Short lead couples the 24 Mc component into the Telechrome transmitter at the 24 mc point, which is the former crystal socket. The transformer mounted below the 1462-A1 is a 6.3v ac filament transformer. Tuning controls are on top and on the front of the 1462-A1.

slugs and capacitors should be peaked for maximum output. The input to the final 2C39A tubes will run about 150 watts fully loaded, and at this input, something over 50 watts rf output will result. A properly rated modulator may be inserted into the 500 volt line to the final stage for high level modulation. While this may not be the very best way to modulate a grounded-grid stage, it does work satisfactorily. Should the unit be used as an AM driver for a larger 220 mc final amplifier, as is used at this station, the plate voltage on the 2C39A's may be reduced down to that necessary for the proper rf output. For example, using only 250v dc and drawing a current of 150 ma (37.5 watts dc input) an output of 15 watts is produced. This drives a modified surplus TRA-19 final to 200 watts input, and with an efficiency of 50%, will represent 100 watts rf output into the transmission line. The 1462-A1 unit of course, with its capability of 50 watts plus output, will most certainly drive anything in the way of a 1kw, 220 mc

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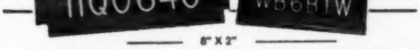

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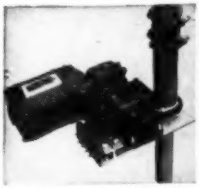

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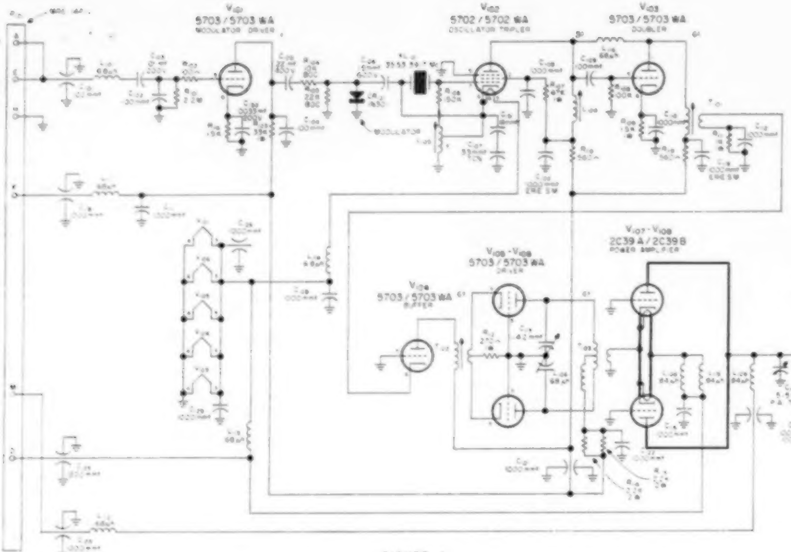

V101
5703 / 5703 WA
MODULATOR DRIVER
V102
5702 / 5702 WA
OSCILLATOR TRIPLER
V103
5703 / 5703 WA
DOUBLER
FM INPUT
MODULATOR
V104
5703 / 5703 WA
BUFFER
V105 - V106
5703 / 5703 WA
DRIVER
V107 - V108
2C39 A / 2C39 B
POWER AMPLIFIER
R.F. OUTPUT
P.A. TUNING

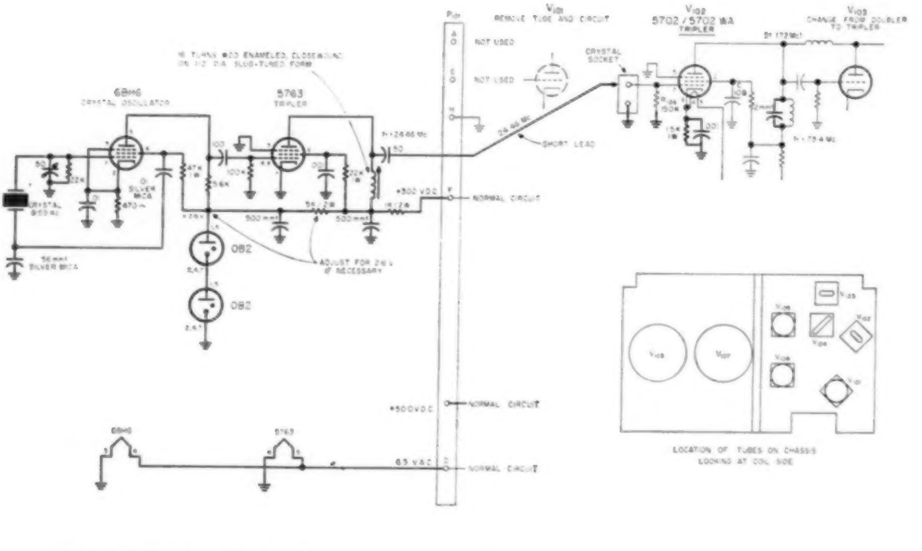
FIGURE 1

final, if desired.

Units such as the 1462-A1 are gradually becoming more available as time passes—actually they are more or less obsolete in telemetry applications, and by regulations, the telemetry business will gradually vacate the 216 mc region during the next few years, moving to much higher frequencies.

This sort of a situation should make quite a few interesting equipments available for 220 mc ham operations.

. . . W5AJG


V101
REMOVE TUBE AND CIRCUIT
V102
5702 / 5702 WA
TRIPLER
V103
CHANGE FROM DOUBLER TO TRIPLER
16 TURNS #20 ENAMELED, CLOSEWOUND ON 1/2" DIA. SLUG-TUNED FORM
6BH6
CRYSTAL OSCILLATOR
5763
TRIPLER
CRYSTAL
NOT USED
NOT USED
CRYSTAL SOCKET
SHORT LEAD
OB2
OB2
ADJUST FOR 210 V IF NECESSARY
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NORMAL CIRCUIT
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NORMAL CIRCUIT
6BH6
5763
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FIGURE 2
Changes in heavy lines

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2 Meter AM & SSB Transmitters from the T-28/APT-1

Leroy May W5AJG
9428 Hobart St.
Dallas 18, Texas

Photo credit: Jim Dungan, Dallas

The surplus transmitter T-28/APT-1 is another in a series of Radar Jamming units which were used during WW-II to cover a wide range of VHF-UHF frequencies. It covers the frequency range from approximately 90-220 mc. Since this excursion crosses the 144 mc amateur assignment, approximately the same techniques used in the conversion of the ARQ-8, elsewhere in this issue, may be used to convert one of these units into a 2 meter AM transmitter or driver. Likewise, a second T-28/APT-1 may be used to convert into an SSB transmitter or exciter, in the manner of the two previously described ARQ-8, 50 mc units. Only the rf sections of these equipments are used.

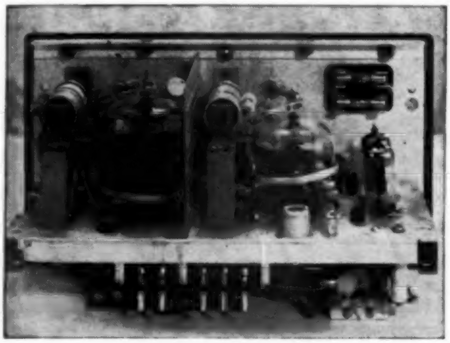
Roller coil inductors (rollo coils) in contact with small wheels riding along the individual turns of the coils are used in this higher frequency T-28/APT-1 unit, and the final stage may again employ either a type 832A tube or an 829B tube, according to the power output desired. Most of the T-28/APT-1 transmitters came equipped with the 832A type installed in the final tube socket.

Fig. 1 shows the original wire traced schematic circuit of the T-28/APT-1. Fig. 2 shows the AM modification—and Fig. 3 covers the necessary SSB modifications. Since most of the details given in the previous article, concerning 50 mc, will also apply to the present conversions on 144 mc, it is recommended that you read it before starting these alterations. On these two modified schematic diagrams, the original components are left unmarked, while the added or changed parts are so indicated with their new values.

Power outputs of the units will be somewhat similar to the 50 mc versions, that is, the AM transmitter will produce from 18 to 50 watts carrier power output, depending upon the final tube used, while the SSB transmitter PEP input can be anything from about 35 watts to 150 watts.

Modifications

To convert into an AM unit: The panel mounting arrangement and shielding requirements are identical to the T-51A/ARQ-8 as modified into a 50 mc AM transmitter. In this case of the T-28/APT-1 modified into a 144 mc AM rig, the first order of business is to eliminate the push-pull, self-excited oscillator using type 6C4 tubes, and insert in their place,



a crystal-oscillator, doubler stage using a type 6BH6 tube. Easily obtained 8 mc type crystals may be used here, with the plate circuit doubling to 16 mc. A second type 6BH6 tube operating as a tripler, will multiply the 16 mc output to 48 mc, and this will then be link coupled to the 1st 832A stage grid circuit. As in the previous transmitters, this 832A stage was originally a mixer, accepting rf drive plus wide band noise. This is no longer needed and the stage in question merely becomes a conventional type tripler, with the grid resonant to 48 mc and the plate circuit tuning the 144 mc frequency.

This 832A tripler will in turn drive the final 144 mc straight-through Class "C" amplifier, which will be either an 832A type or an 829B type, depending upon the power output desired. When changing the final tube type, it will be necessary to change the value of the grid resistor as well as the screen dropping resistor associated with this stage. The schematic of Fig. 1 details such necessary changes. A key jack is indicated on this AM version, and should CW operation be desirable, the power input may be upped a bit more, without damage to the 829B tube.

Now, regarding the plate circuit rollo coils when using this maximum type power input—it is true that the heavy duty cycle type Class "C" operation can very likely cause the roller contact of the rollo coils to tend towards some arcing, and possibly some heating, if very much tuning is done under such full power. This was mentioned in the previously published 50 mc AM conversion of the T-51A/ARQ-8, and it was there stated, that somewhat better efficiency might be obtained by removing this final plate circuit rollo coil and replacing with an L-C combination specifically resonant to the operating frequency. Such an arrangement can be duplicated in the T-28/APT-1, if desired, by mounting a coil and variable capacitor resonant to 144 mc in place of the original rollo coil and output circuit. A one or two turn link for rf output will replace the original T-28/APT-1 output circuit. A combination that is useable may take the form of a 10 mmfd per section split-stator capacitor in conjunction with a coil of two turns of No. 12 enamelled wire, wound on a 1⅜ inch diameter, spaced ½ inch, tapped in the center for the HV connection.

If an 832A is used in the final or if the 829B type tube is throttled down in power input, this change in the final L-C circuit is hardly worth while, as no decrease in efficiency or unwarranted heating will occur at about the 20 watt output level. In any event, it is recommended that the original rollo coil be left intact even with the higher power, and if trouble is encountered, then corrective steps

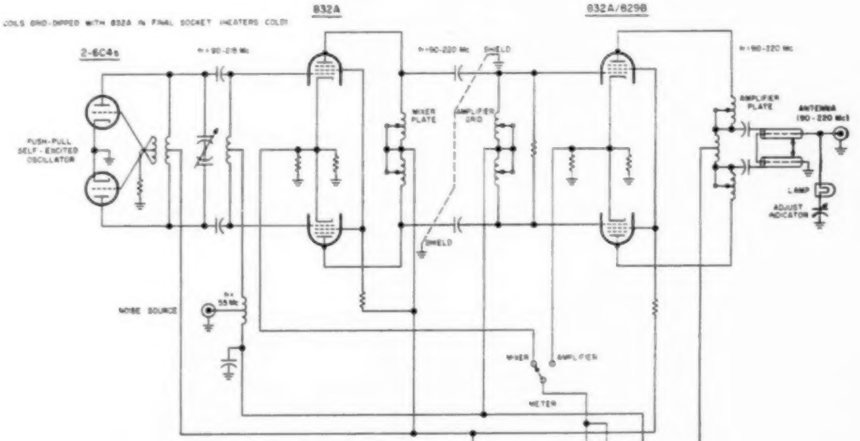


FIGURE 1

can be taken.

Should high-level Class "C" AM modulation be desired, the modulator may be inserted in the high-voltage lead of the final tube. A modulator capable of from 15 to 50 watts audio output will be required, according to the final rf tube selected. Used as an AM transmitter then, one can reasonably expect the following performance; using an 832A in the final, the input for Class "C" AM phone operation will be 32 watts. The efficiency, (dc input to rf output) will run around 55% or so, which will result in an output of about 18 watts carrier power. On CW operation, this input may be raised to at least 40 watts and will result in a 22 watt output carrier. Using an 829B in the final, the input for Class "C" AM phone operation will be 100 watts. The efficiency will run about 50% and will produce an output of at least 50 watts carrier power. On CW operation, this input may be raised to at least 120 watts and will result in a 65 watt output carrier. The screen voltage and current will be about 200v dc and 30 ma. Grid current should run 10 or 12 ma. Keying is accomplished via a closed circuit key jack in the final cathode circuit.

To convert into an SSB unit: Procure a second identical T-28/APT-1 unit and proceed as follows, referring to Fig. 3. The first step here is to replace once more the 6C4's. This time, the crystal oscillator-tripler tube to be installed is a twin-triode 6J6 type. The crystal frequency will be 41.0 mc, tripling in the second half of the 6J6, to 123 mc. This frequency is then amplified by a new buffer tube (6BH6) and this tube in turn drives the first 832A high level mixer via its new grid coil. All up to this point assumes 21 mc SSB energy available from a 20A or something similar, in order to mix to 144 mc. Should another SSB frequency be desired, such as 14 mc, then the injection string will have to be altered to suit. This was discussed at some length in the original article on the T-51A/ARQ-8 set-up. The plate voltage of the crystal oscillator portion of the 6J6, as well as the plate of the tripler, is regulated for best stability. This is procured from an external +150 volt regulated supply and these two stages should run continuously, coming on with the heaters of all the tubes. The four new coils to be wound will be L-1, L-2, L-3 and L-4. The first three are ordinary slug tune units resonant to either 41 mc or 123 mc. The coil L-4 is to be resonated with the 832A tube input capacitance to 123 mc. Coupling from L-3 to L-4 consists of two-turn links on either coil. A new grid-leak of 10k connects from the center of L-4 to ground.

21 mc SSB energy is fed into the cathode of the first 832A through the 500 mmfd coupling capacitor. The screen voltage on this

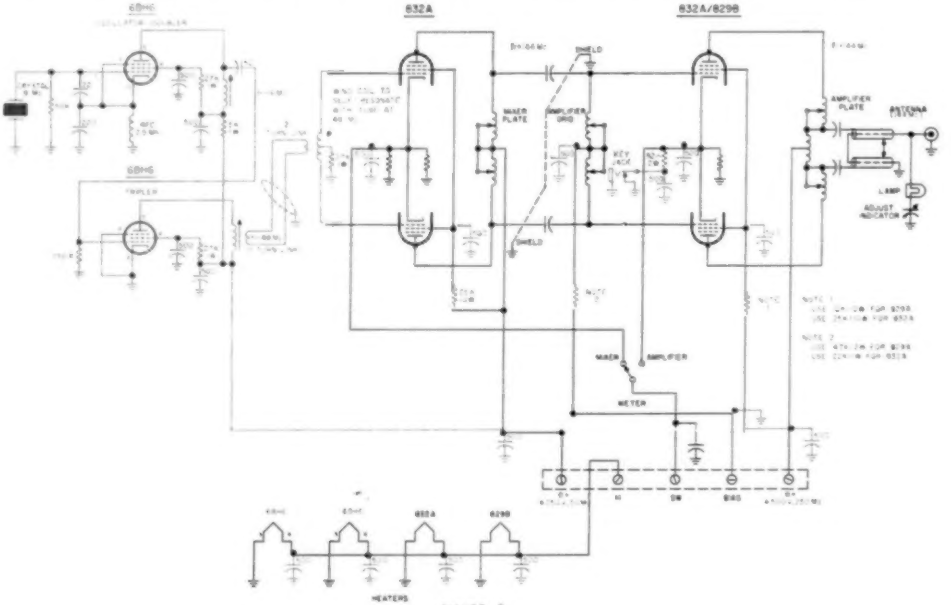


FIGURE 2

Added Components in red

832A mixer tube is derived from a 5k, 5 watt resistor from the 250 volt supply furnishing voltage for the 6BH6 plate and screen and for the 832A mixer plate.

Changes in the final stage to operate in a linear fashion, will first depend on the choice of tubes, either the 832A or the 829B type. The screen grid voltage dropping resistor may be adjusted so that the two OB2 regulator tubes fire properly to provide the regulated 216 volts dc. The rollo coils associated with the plate circuit of the previous 832A mixer stage, the grid circuit of the final and the plate circuit of the final will remain as is. Unlike the AM modification just described using the 829B tube, this SSB version will not require the substitution of a new final tank circuit. This is of course due to the lighter duty cycle of this mode of operation. It will be necessary, however, to provide some fixed bias for the final 832A/829B linear stage to set the proper resting plate current, which will be approximately 10 ma for the 832A and 15 ma for the 829B. This will end up around −15 to −25 volts or so and may be provided by a small silicon supply with a variable pot for exact adjustment.

As for power delivered in the SSB version; Should the 832A be used in the final, an input of from 35 to 45 watts pep may be used. This will result in an output of from 15 to 20 watts pep and will be more than enough to drive any grounded cathode type linear amplifier, such as push-pull 4X250B's to maximum power on 144 mc. Should the T-28/-APT-1 be used as a complete transmitter without a following higher power amplifier, then of course, the choice should be the 829B tube (or perhaps an 5894). This tube will allow an input of some 120 to 150 watts PEP and will deliver on the order of from 60 to 70 watts PEP output. Plate voltage may be anything on up to 750 volts.

This particular unit was checked out at this station using an 829B tube with a plate supply of 600v dc. The screen was regulated at the usual 216 volts and the final negative bias was approximately −25 volts. Resting plate current was 15 ma. With a two-tone test signal driving the final plate current to 100 ma, an output of 30 watts average power was measured. Speech easily drives the unit up to the 70 watts pep output mentioned above.

L_1 = Slug tuned ceramic form ¼″ dia—15 turns #24 onem close wound.
L_2-L_3 = Slug tuned ceramic form ¼″ dia— 9 turns #22 onem—½″ long.
L_4 = 10 turns #16 tinned ½″ dia.—1″ long winding—center tapped.
(Resonate all coils to frequency with GDO)

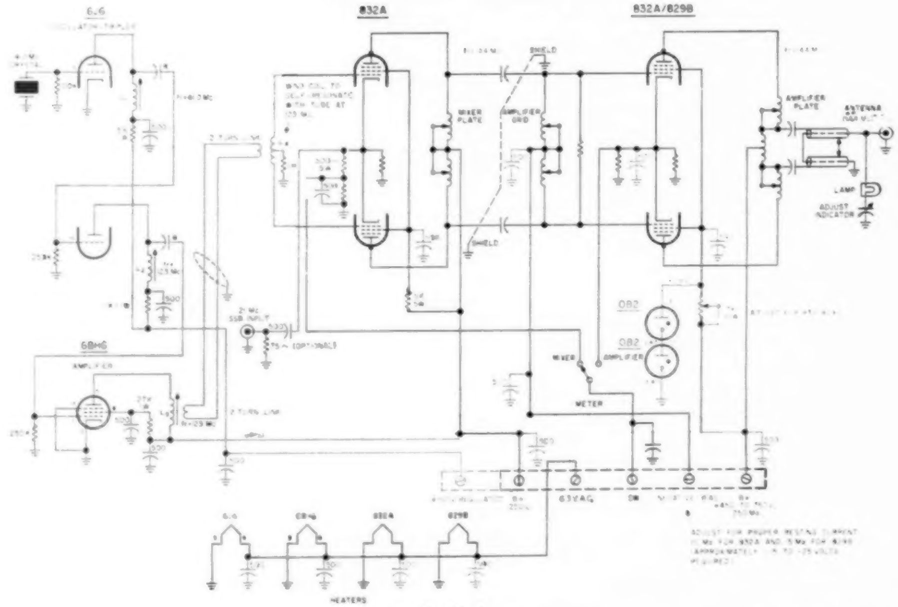

6J6
832A
832A/829B
CRYSTAL
WIND COIL TO SELF RESONATE WITH TUBE AT 123 MC
2 TURN LINK
MIXER PLATE
SHIELD
AMPLIFIER GRID
AMPLIFIER PLATE
ANTENNA
LAMP
ADJUST INDICATOR
21 MC SSB INPUT
75 Ω (OPTIONAL)
6BH6
AMPLIFIER
2 TURN LINK
OB2
OB2
MIXER
AMPLIFIER
METER
B+ 250V
6.3VAC
B+
6J6
6BH6
832A
829B
HEATERS

FIGURE 3

Added components in red. The "mixer" lead (shown in black) coming from the meter switch should be connected to the center point of the resistor divider (shown in red) in the cathode of the first 832A.

The rollo coils will not require retuning unless excursions in frequency of more than several hundred kilocycles becomes necessary.

A word about TVI. According to the local situation, it may be necessary in some locations to go to a bit more trouble in the shielding of this unit, as well as filtering of the heater and plate supply leads. Standard de-TVI procedures should be used. Also close attention should be paid to ascertain if any unwanted spurious products are present due to the mixing process. Be very careful to see that the injection frequency used to mix with the SSB energy does not leak through the final. Either 130 mc (used with 14 mc SSB), or 123 mc (used with 21 mc SSB) must not be allowed to radiate. A reentrant cavity filter between the transmitter *if* feeding the antenna or between this transmitter and the following higher power linear, is excellent insurance towards helping prevent troubles of this nature.

Further Suggestions

The preceding work was an assignment project of the Central Technical Net of A.F. MARS in Texas and as such, several of the units were distributed to different workers for experimentation.

One interesting variation originated with K5JHG Skeets Hogan of Atlanta, Texas, who came up with a very simple modification to put the T-28/APT-1 to work on NBFM on 144 mc. Essentially, this modification follows the above described AM version alterations, but with the following changes referring to Fig. 4, instead of using type 6BH6 tubes in the crystal oscillator-multiplier string as set forth in Fig. 2, K5JHG substituted a type 6AK5 for the crystal oscillator-doubler, and used a 12 mc crystal–doubling in the plate to 24 mc. This then, drives into another type 6AK5 doubler with its plate circuit resonant to 48 mc. From here on out, the balance of the modification follows that of Fig. 2–that is–the 48 mc energy is fed into the first 832A tripler tube of the T-28/APT-1, and thence to the final.

To accomplish the NBFM bit, a type 6SL7 double triode tube is used as a speech amplifier with a carbon mike inserted in the cathode of the first section. The plate of the second amplifier section is coupled through a capacitor of .01 mmfd to the screen of the 6AK5 crystal-doubler tube. Apparently, the audio voltage from the 6SL7 impressed across the screen resistor of the 6AK5 modulates the electron stream of the tube, accomplishing a combination of both frequency modulation as well as some residual amplitude modulation of the crystal-doubler tube. Since the multiplier stages following this tube operate under Class "C" conditions, the AM component is virtually washed out by the FM limiter action, and when multiplied to the final frequency of 144 mc, only NBFM remains. K5JHG uses this T-28/APT-1 NBFM unit as a driver for his 144 mc 4X150A final amplifier as well as a driver for his 432 mc tripler set. This arrangement appears to work very well on both 144 mc and 432 mc and is mentioned as a further example of the versatility of the T-28/APT-1 surplus set.

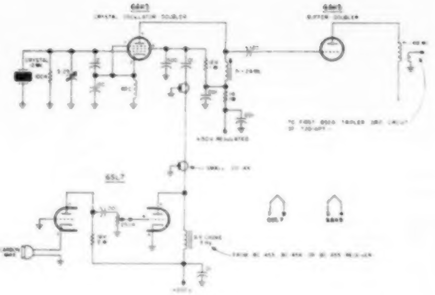


FIGURE 4

Other arrangements may also be used to produce frequency or phase modulation in the T-28/APT-1. Several schemes are discussed by Frank Jones in his "VHF For The Radio Amateur." A very attractive scheme is the bridged-T type phase modulator uesd in conjunction with 8 mc crystals and could conveniently be adapted to this T-28 unit.

. . . W5AJG

On receiving 3 copies of 73

Of strange status symbols I often have heard,
But a three copy family's strangely absurd.
There's one for Me, and one for my filius,
And one for my Wife—that's kind of silius.
My son only eats it—he's less than a year, . .
Says my wife, ". . . Homebrew means some kind of beer?"
Yet even so, I think the joke is immense,
Not merely because it's at Wayne Green's expense,
But in 73 humor's endemic,
And 'Twas easy avoiding a lengthy polemic.
So like Egypt's kham-sin-in March invariable,
I need no fourth since that's only buryable

Similia Similibus Curantur
Bob Robbins—K3HTB

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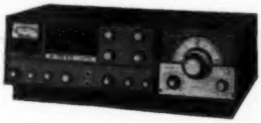

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COLLINS 75S3 Receiver, late serial #, 1/new	495.00
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Correspondence from the Members

Letters we bet you won't see in QST

Gentlemen:

Thanks for your notice of expiration of my membership in the ARRL.

In reference to the second paragraph on the expiration notice, I have decidedly NOT valued my membership in said organization, inasmuch as it seems they are now making every effort to cause me to lose the Amateur Radio License (Conditional) which they helped me to get.

Over the past omnths I have carefully studied both the pros and cons of the current controversy which your organization has promoted as regards incentive licensnig, and I feel that the ARRL, which through never-tiring efforts, is even today swelling the ranks of Amateur Radio through the media of its organized classes, contests, certificates, etc, has achieved the pinnacle of hypocrisy in submitting, **without the concurrence of the membership which it claims to represent**, a petition, the results of which **must**, according to one's viewpoint, either severely curtail the privileges of a large percentage of American radio amateurs or present a minority group of same with unwarranted (not un-earned, but un-warranted) privileges at the expense of the larger group.

I do not write this letter in argument to statistics—you, not I, have the statisticians in employ. I **do** argue that it is **your** campaigning which has created the current crowding of the amateur bands which you so deplore; Yet, while the right hand deplores this crowding and solicits legislation to alleviate it, the left continues to campaign for greater memebrship (and crowding) in the ranks of Amateur Radio. Neither do I refute the statements which imply that your fear the "young nations" of the world will have little sympathy for a group of radio amateurs in the United States. I do, however, to a considerable degree listen to the amateur bands in Europe, and at the same time study enough international politics to realize that the elimination of the privileges of a large group of U. S. licensed radio amateurs to the benefit of a minority thereof will not make one iota of difference to these "young nations" in their clamor for more of the radio spectrum.

From the above expression of my opinion, gentlemen, you will perhaps have some inkling of the reason for my failure to renew my membership, and for my campaigning within my modest circle, for others to follow my example.

I have for some years been a member of another organization which claims to represent the desires of its membership, and from experience with it I have become highly critical of organizations which pay lip-service to representation, vowing never again to knowingly maintain connections with an organization which follows the "You boys just keep quiet and do what we tell you—we know what's best for you!" line. I refer to the Air Line Pilots Association, once powerful and with a fanatically loyal membership; subject within the last two years to a devastating internal political shapeup, including a loss of 20% of their paying membership—all as a direct consequence of a ". . . we know what's best . . ." philosophy, and an unwillingness to swallow their pride, back down and follow the will of the membership.

The purpose then, of this letter, is to answer a question and to ask one. The question "Why are you not renewing your membership?" I have already answered. The question I direct to you is: Are you gentlemen of the ARRL board smarter than the deposed politicians of the ALPA—can you learn by their mistakes, or will you, as they did, ignore the clamor of the members until the organization threatens to topple?

Robert G. Gross, Jr.
WA6YGX/DJ0IC

Dear Mr. Huntoon:

I received your form letter of welcoming me back to the League for another year. Before you go ahead and use my rejoining the ARRL as part of your statictics of being in favor of the Leagues proposal RM-449, please read on.

At the beginning of this fine mess that the League had started, my first thought was to let my time run out of being a member of the ARRL. Then with a little more serious thought I decided that the right way is to do my best and help (by vote) put a director in office who cannot be "brow beaten" and become a "yes-man", once he returned to the "Home Office". If enough areas would work on this program I believe the League would be in a much better position than it is now.

So my main reason of rejoining the League is to cast my vote for a new Southwestern Division Director and to cast my vote (if we are ever given that privilege by the League) against **RM-499.** I am sick and tired of reading of the so-called 16-0 voting by the Directors! ! The ARRL has torn apart a fine organization and has set it back at least ten years!

Not only am I a member of the ARRL. I have also joined The Institute of Amateur Radio. The ARRL Booster Pin I once proudly wore not sits in the dresser drawer, my efforts now will go to the IOAR to help make it a stronger organization.

Maybe stronger competition will make the ARRL sit up and take notice that they do not control as many of its members they think they do.

The League is a great one for different contests, why don't you put your heads together and come up with some types that would make 10 and 15 meters the MAJOR bands. Help promote these bands now and we stand a great chance of keeping them.

It is very true that the commercial field is looking at our bands for the relief of their crowed bands. But the way you plan is far from the answer.

Donald A. Cofone, W6RDB

Dear Sirs:

I am returning the enclosed notice of subscription expiration I do not wish my subscription renewed.

Since subscribing in 1956 I noted that QST was not aimed at the man who was an "operator" and an "amateur". The articles were consistantly slanted toward the technician who was a semi-professional in the electronics field. Older hams told me at the time I received my license that "you get the deep stuff in QST and useable information in CQ". As CQ in recent years has followed QST the hams now refer novices to a new magazine "73" for the same reason they used to recommend CQ.

There is, of course, the matter of league membership. Yet, to support an organization, one must feel the organization supports the majority of its members. This the league does not do. Whether it is in aiding those defending themselves against a lawsuit aimed at all of us, or in recognizing that the vast majority of its members are general and conditional class (according to the leagues own figures) and setting policies accordingly, the league fails.

Its officers consider themselves a technological elite for whom the FCC must make special provision in its regulations to the detriment of the majority of the membership. No organization can expect to receive membership support on such a self-centered policy.

Even the arguments put forth by the league in its plea for higher technical requirements for licensing are confused. In effect it says: "Because manufactured rigs are better and cheaper than those a ham can make, a ham does not need to know so much—so we propose that he be required to know more.." This is certainly moving in a direction opposite to the presented evidence. Another hams petition giving the lower end of the CW bands to Advanced and Extra licenses for phone would deprive no one and still provide an incentive. These frequencies are empty and the CB's may get them (or commercial interest).

As a conditional licensee I do not appreciate the leagues' point of view that I hold a "Sears and Roebuck license". An ex-army air corps radio operator-mechanic, I found the examination simple despite a 12 year absence from code operating. I am not only active in many public service projects, but originate many of them (see page 60, June 1961 CQ). Being a freelance writer I see that the local newspapers where I am stationed know we do more than cause TVI. I hold nothing against the hot soldering-iron types, but I make my contribution to ham radio too.

QST has just not kept up with the "state of the art."

Ross A. Sheldon K4HKD (ex K5UCH)
Huntsville, Alabama

FCC Rule Changes

215

The following rules changes have been made by the FCC, effective March 18th.

§ 97.13 Renewal or modification of amateur operator license.

(d) Application for renewal and/or modification (change of address, etc.) of an amateur operator license shall be submitted on FCC Form 610 and shall be accompanied by the applicant's license. Application for renewal of unexpired licenses must be made during the license term and should be filed during the last 60 days of such term. In accordance with the provisions of this quarter, made timely and sufficient application for renewal of an unexpired license, no license with reference to any activity of a continuing nature shall expire until such application shall have been finally determined.

e) If a license is allowed to expire, application for renewal may be made during a period of grace of one year after the expiration date. During this one year period of grace, an expired license is not valid. A license renewed during the grace period will be dated currently and will not be backdated to the date of its expiration. Application for renewal shall be submitted on FCC Form 610 and shall be accompanied by the applicant's expired license.

§ 97.47 Renewal and/or modification of amateur station license.

(a) Application for renewal and/or modification (change of address, etc.) of any station license shall be submitted on FCC Form 610. In every case the application shall be accompanied by the applicant's license. Applications for renewal of unexpired licenses must be made during the license term and should be filed during the last 60 days of such term. In any case in which the licensee has, in accordance with the provisions of this chapter, made timely and sufficient application for renewal of an unexpired license, no license with reference to any activity of a continuing nature shall expire until such application shall have been finally determined.

(b) If a license is allowed to expire, application for renewal may be made during a period of grace of one year after the expiration date. During this one year period of grace, an expired license is not valid. A license renewed during the grace period will be dated currently and will not be backdated to the date of expiration. Applications shall be submitted on FCC Form 610 and shall be accompanied by the applicant's expired license.

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Ea. add'tl lb.	.06	.08	.10	.13	.16	.19

REDLINE

[redacted]

JAFFREY, N. H.

Letters

Dear Wayne,

I have never felt the necessity to write to an editor before, but considering the effect that the ARRL proposal would have on our wonderful hobby of amateur radio I believe it is very necessary for me to express my views on the matter.

When the ARRL first introduced its so-called "Incentive Licensing" program I wasn't very impressed by the idea, since it would mean wasting time memorizing answers to more test questions, time which could be better spent experimenting or increasing operating proficiency; and this to retain what we already have! Other reasons for opposition soon came out, reasons which were consistently more sound than those for its support. For one thing human nature cannot be changed by legislation. Congress tried to do so by amending the Constitution to prohibit the sale of liquor in the United States, thereby hoping to promote temperance among Americans; however it soon became apparent that, if anything, more people were drinking because of this law than less, and the 18th Amendment was soon repealed. The current civil rights controversy is also a good illustration. Thus if amateurs are indeed a lazy lot, as the ARRL seems to think, stiffer tests aren't going to change things one bit.

But I don't think that most of us are so technically ignorant. Many hams here in Moorhead have very well-equipped workshops and spend much time on home construction projects; it there any better way to bring home textbook data than in terms of practical experience with the theory involved? On-the-air discussions also often center around technical problems encountered with transmitters, antennas, etc. Hams lazy? I think not.

Further, if this proposal were placed into effect it would cause a considerable increase in work and expense for the FCC. They would be compelled to spend large sums of money (our money!) devising and printing all of the suddenly required tests; moreover, since there is no differnce in calls among the Conditional through Extra classes it would be very easy for the former to continue using the latter's "privileges" unless the FCC hired many more monitors to police us (more of our money). I have always favored minimum government intervention in anything, and this is certainly much more than minimum.

These are all very good reasons for opposing the measure, but the clincher appears, ironically, in QST itself. I am referring to the "Correspondence from Members" columns in several of the recent issues. After close scrutiny it became evident that there was more than chance involved in the order of the letters. One or two would first appear opposing the measure, abruptly followed by one in favor of it arguing on the same points, as if to refute the previous points. This sort of spacing has been too consistent to be mere coincidence. Does the ARRL have so little confidence in the merits of the proposal that it must resort to tactics such as these to win approval of it by us amateurs? Does it, indeed, have any merits good enough to have it forced on us by government decree?

I am sure the ARRL is sincerely interested in improving the technical calibre of amateurs in general; but there are means of doing this that are much better than such drastic proposals. One of these is to change the structure of QST magazine. At present only about a third of the magazines is devoted to technical material; what is there is excellent, but there isn't enough of it. Even the ads lean very heavily toward commercial gear. So why not have QST feature more theory and construction material and solicit more ads concerning parts needed in homebrew equipment, rather than placing so much emphasis on operating and completely commercial gear.

However, if we still must accept more government control there are still better ways of accomplishing it, and much less expensive too. Begin by giving Advanced and Extra closs licensees their own distinctive calls; then give each of these two classes phone privileges on small portions of what are now CW only segments. This would be true incentive licensing. The higher grades would then become real status symbols, and be something to work for.

So I believe that this proposal is not only unnecessary but also very unwise. Thank you for giving me this opportunity to express my opinions.

Dave McFarland, WA0DAM

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Our Readers Answer CQ's Editorial

Dear Wayne:

Well, well, well . . . CQ finally got off the fence. I wonder who pushed them?

I fully agree with the Editor of CQ that one should be a little bit more sure of his facts before running editorials, but I guess he wasn't too worried about this because he was leaving anyhow.

Just for the amusement of it, lets see what he said:

1. "The time "To Be Counted" statistics were written before the ink was dry on the February issue." As you will note this answer to a May editorial appears in the June issue and Wayne did not have to skip a month to answer it. So much for that.
2. "The CQ proposal was warmly received." No argument, it should have been, as it was completely unoriginal and on the only point that was raised, i.e. power increase, they took their lumps. Any **active** ham would have known this would happen.
3. "They have made no proposal before the FCC", real safe isn't it, to have a proposal and make no proposal.
4. Yes you have more than just one call as do thousands of other amateurs who also possess a citizen's band call, including the editor of CQ and his boss, the son of the publisher of CQ. (By the way Richard, isn't it time you at least tried for your General?)
5. An accounting of the monies of the Institute of Amateur Radio was presented to its Board of Directors and appears in the previous issue of '73' and prior to any requests for same. It clearly shows zero expense reimbursement. How much has CQ spent to benefit anyone but CQ.
6. CQ claims that your petition to the FCC is similar to theirs. Your petition was filed February 20th, before the March issue of CQ was out after having first appeared in the January issue of '73' (you will note that this is the required time, according to CQ to do a copy job) so . . . assuming it is true that the proposal appearing in CQ is similar to yours and yours appeared two months before theirs, I leave it to you as to who is the copycat.

I would suggest that engaging in a name calling contest, you check your own skirts to make sure they are clean. The ARRL was invited to check the count and postmarks on 73's ballot. Neither they, nor CQ requested to do so.

Sounds like the old saying, "Don't confuse me with the facts, my mind is made up."

I sincerely hope the CQ Editor enjoyed his name calling game and "when did you stop beating your wife" type of questions. Every child is entitled to a tantrum once in awhile.

Good luck on his next job.

IoAR Member
New York

By W4RLS

CQ Magazine in its May, 1964 issue, contained an editorial headed "Zero Bias," which was nothing more than a character attack upon Wayne Green, the editor and publisher of **73 Magazine**. Numerous comments have already been made on the air by various amateurs to the effect that character assassination like this has no place in the pages of purportedly responsible publication, and it is certain that the heading of the column is unworthy and untrue, in view of its obviously heavily biased content. This writer would label the column "Zero Potential," because it certainly is totally without voltage in our eyes!

Wayne Green normally needs no help in defending himself, and that is not the purpose of this letter. My purpose is simply to protest this kind of vicious attack in print on anyone.

First, the accusation is made that Wayne tallied the votes on his postcard poll concerning RM-499 before the ballots were distributed. This is the sort of irresponsible approach which Mr. Goebbels used to such good advantage about thirty years ago in Germany. Wayne has offered in the May issue of **73** to allow the ballots to be audited and has asured the A.R.R.L. that every ballot which they have been informed was mailed in favoring RM-499 is definitely included in the group. The entire collection is there, and before anyone hurls the lie at Mr. Green, that someone ought to accept his invitation to audit those ballots! The results of his poll, eighty per cent opposed to RM-499, are borne out in my eyes by virtue of the fact that examination of the file which the FCC has compiled on RM-499, previously reported in 73, showed the same ratio of opposition.

The second accusation is that **73 Magazine** changed its attitude on incentive licensing. Whether it did or not is not the question, for certainly CQ did the fastest turnabout on record on its March issue! From a position of abject camp-following, swallowing the A.R.R.L. line hook and sinker, suddenly **CQ Magazine** discovered that there were possible methods of incentive licensing other that RM-499! Evidently, the editor of **CQ** has been reading **Monitor**! Since I orginated the so-called W4RLS Plan, which has by far the most support of all the proposals in the FCC file, based on the signatures in that file, I am particularly gratified that both **73 Magazine** and **CQ Magazine** have adopted similar positions. Nevertheless, I do not consider that **73** turned its coat, since the position now occupied by **73** is, to my view, not inconsistent with its previous opposition to the A.R.R.L. form of "Incentive Licensing". The position now adopted by **CQ** on the other hand, is in direct opposition to its editorial position to which it held through February, 1964, and then suddenly turned 180 degrees out of phase in the March issue of the magazine, with no explanation and no apology for the sudden turn in direction. The editorial in CQ further accused Wayne of deliberately misguiding his reads, of malice, and of himself joining the ranks of "Me Too'ers." Now the CQ editor made his determination of "Deliberately" misguiding his readers, and how he arrived at his conclusion of malice, he does not explain. He offers no evidence. Perhaps he can read minds? Accusations like this have no place in the field of honorable discussion. Nor do I believe Wayne to be guilty of the accusation that he has also become a "Me Too'er." What he advocates in his currently

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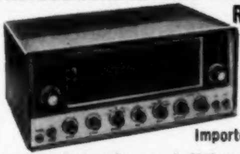

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pending FCC petition (RM-577) is closely parallel to the W4RLS Plan, and is **greatly** different from RM-499. I happen to be in position to refute the accusation that Wayne borrowed his proposal from **CQ Magazine**. I had been in correspondence with Wayne for several months concerning the W4RLS Plan as opposed to RM-499, and I know that Wayne's own version of this approach to incentive licensing was his own and was not borrowed from the March issue of **CQ Magazine**. Quite the contrary, I strongly suspect that both plans, that of Wayne's and that of CQ's, were greatly indebted in their inspiration to the W4RLS Plan!

The "Zero Bias" editorial contains an entire paragraph amounting to no more than a character assassination attack, a mere diatribe, and reflects more discredit on its author than it possibly could upon its target. I am also in position to know that the accusation leveled at Wayne of organizing he Institute of Amateur Radio just to grab off $10.00 donations for his own pocket is utterly false. I am one of the organizing directors of that organization, and am going on record here and now as stating that not only has Wayne offered free space in **73 Magazine** to report the doings of the Institute, but that every dime of the money has been accounted for, is in the possession of the Institute, which is duly incorporated, and that Wayne refused payment for the free space in **73 Magazine**, despite the fact that the directors did not think it was fair for the Institue to ride free and urged him to accept payment. He stated that he wanted to go "the last mile" in order in every way to show that he had no profiteering motive in connection with the Institute. He wanted to protect the Institute from the sort of false accusation as the one under discussion.

Certainly, a subscription to **73 Magazine** is extra. The purposes of the institute are strictly limited to an attempt to benefit amateur radio. It is not the purpose of the institute to boost a magazine. The directors expect to run the institute and try to carry out its program and purposes which are intended to supplement those of the A.R.R.L., and to fill in the areas where A.R.R.L. either will not or cannot take the necessary action for the benefit of amateur radio.

I do not pretend to agree with any one person fully, nor to claim perfection for anyone, including myself. Nevertheless, I am proud to be associated on the board of IOAR with such men as the following: Bill Ashby, K2TKN; Wells Chapin, W2DUD, Lloyd Haslam, W3AYA; Maurice Hinden, W6EUV; Harry Longerich, W2GQY/4; Ed Schaad, WA4PDX (W9AIY); Howard Pyle, W7OE; Warren Cannefax, K4AQV.

Harry Longerich is already on the ground in Washington, D. C. as the institute's representative, "lobbyist" if you want to call him that. At any rate, amateur radio now has a man in Washingon, on the spot, for the purpose of selling amateur radio to our own government. The editor of **CQ Magazine** ought to spend his time thinking up or at least boosting progressive ideas to help the cause along, rather than wasting his time, words and venom in personal attacks on others.

Foy Guin, Jr., W4RLS

Letter

Dear Wayne:

Just a note in connection with your editorial in April 73. I would like to say that I feel your idea of giving considerable space in 73 to the qualifications of persons running for the position of ARRL director is a fine idea. During the last southwestern election I was fortunate enough to hear equal time speeches given by all candidates at the Los Angeles Council of Radio Clubs. Needless to say only a small fraction of the division's voting amateurs had such an opportunity, and the small biograhy with the ballot is certainly not enough.

Best wishes in connection with the IOAR and the "man in Washington" project.

Harvey
WA6KZI

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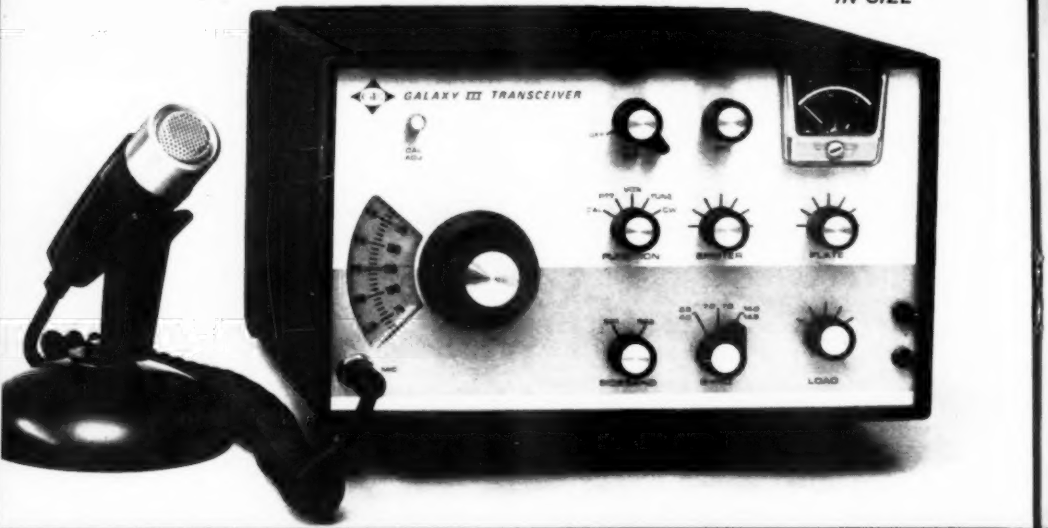
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Using 416B and 8058 Tubes as 432mc Preamps in the CFN-46ADT

Leroy May W5AJG
9428 Hobart St.
Dallas, Texas
Photo credit: Jim Dungan, Dallas

In *73* Magazine for November 1963 there was described a 432 mc converter using the surplus Navy type CFN-46ADT, rf to *if* converter. This was a transponder type military unit as used with a companion radar installation. Towards the last of the article, under "Further suggestions," it was stated that the substitution of W.E. 416B planar triodes, in place of the original 2C40's in the rf stage would improve the operation of the converter in a very substantial way.

It was further stated that the type 8058 nuvistor type had also been substituted for even the 416B's in an effort to evaluate the performance of this newer type RCA tube.

The first thought which will probably come to mind is; which will be the best—the 416B or the 8058? Which route should I go? This is a tough question, and some aspects of the problem will first be discussed, thereby perhaps helping one to decide which road to take.

Here at W5AJG we have modified two of

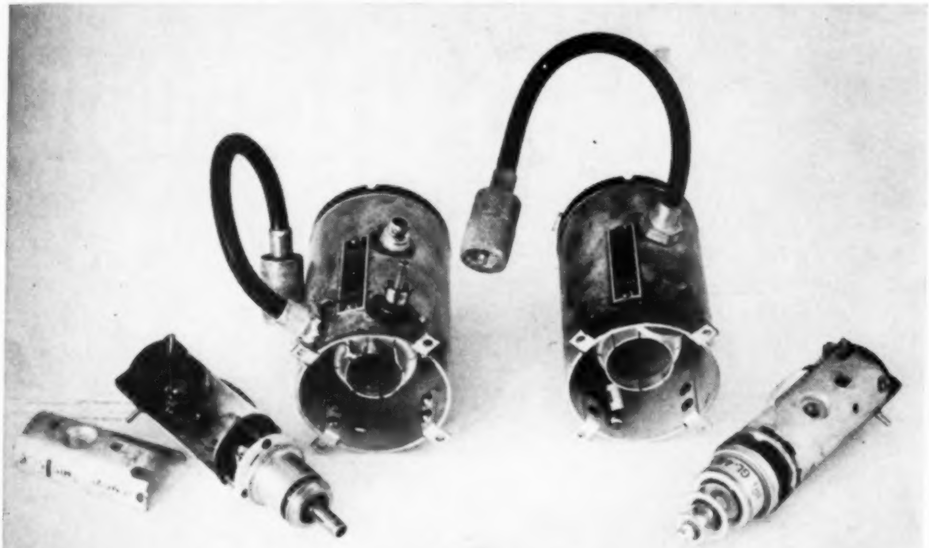

Photo showing modifications to the cathode tanks of the 46ADT to adapt for 416B gold plate planar triodes in place of the original 2C40/446B type tubes. Tank on the left is the modified one. Tank on right is the original unmodified one. Input coax is coupled in to the bottom of the cathode line (at tube) on the left hand line in contrast to the right hand tank where it is coupled in further towards the ground end of the inner conductor.
Silver plated fingers on the left hand tank are bent inwards to firmly contact the cathode shell of the 416B tube.
A quarter inch copper tube extension of the plate cup makes up for the total length deficiency of the 416B tube version.

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the 46ADT units. The first allows us to try 416B type tubes in the two rf stages. The second 46ADT chasis allows us to try the two rf stages of 8058 nuvistors. The two units are quickly interchangable into the same mixer system and thence through the remainder of the receiving setup. In six months of service on the 432 mc band, using out of town signals for comparison purposes, we can truthfully say that we can not tell any practical difference between the two tube types. Therefore, in nearly all cases, we feel the choice would be made for other practical reasons—as to whether it would be 416B's or 8058's on 432 mc.

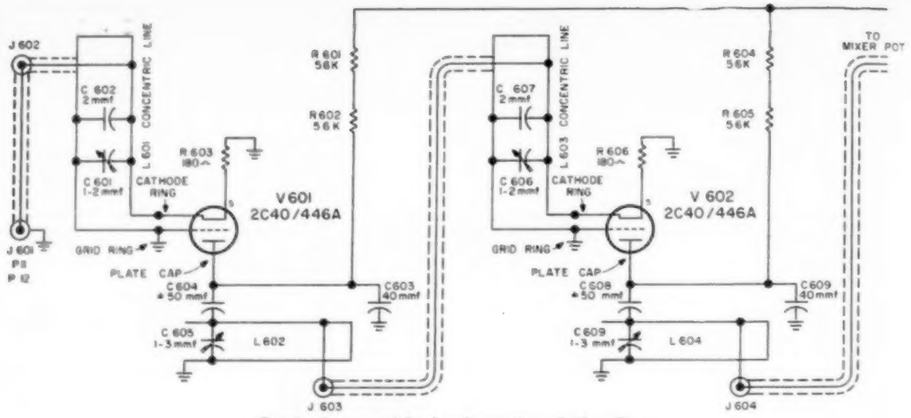
One or two of these practical reasons might be explored a bit before we proceed. The 8058 nuvistor sells for $13.25 at the present time. Right off then, an expenditure of $26.50 must be immediately justified. As against this, the 416B's will cost nothing—in the majority of cases—or at the most, three or four dollars per tube. How important is money, anyhow?

Ease of construction? Well, the 8058's will probably be the easier to get built and plugged in, but there is no great advantage one way or the other. One of the most attractive things about the 8058's will be the absence of any blower—and the low plate voltage required. Using the 416B's at maximum rated electrode voltages, a blower is definitely necessary. Using them at reduced ratings, both as to plate and heater voltages, blowing is definitely *not* necessary. This latter condition is the arrangement that is used and will be described for the 416B's as used in the 46ADT unit.

To boil it all down then—this means if you have the dough, go 8058's. Even if you are rich (but tight), or if you are plain stinking poor, the 416B's will be the route for you.

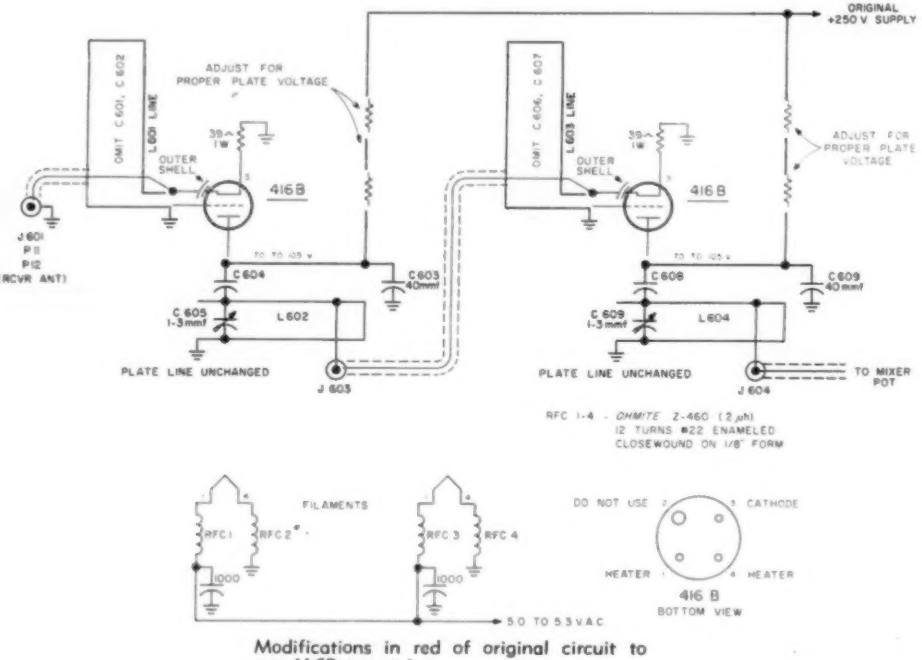
K5JHG, Skeets Hogan of Atlanta, Texas, first suggested the feasibility of modifying existing surplus quarter-wave coax-cavity tanks to accept the 416B gold plated triode tube. Many of these WWII surplus units were designed to use the then new 446A/B or 2C40 type planar-triode tube and with small changes, can be made to work excellently with the 416B type, which is of course, much superior in its performance. The majority of these surplus tank circuits are beautifully built, silver-plated and are unusually stable devices with no signs of monkey business, even when used in cascade fashion. The 46ADT is such a unit.

Before going further into details of the conversion, a word about the method of testing. It must be stated that no test equipment was available to actually measure the absolute noise-figure of the units. A simple diode noise generator was on hand and was used to start


J 602
C 602
2 mmf
L 601 CONCENTRIC LINE
C 601
1-2 mmf
CATHODE RING
GRID RING
J 601
P11
P12
R 601
56K
R 602
56K
R 603
180~
V601
2C40/446A
PLATE CAP
C 604
≈50 mmf
C603
40 mmf
C 605
1-3 mmf
L 602
J 603
C 607
2 mmf
L 603 CONCENTRIC LINE
C 606
1-2 mmf
CATHODE RING
GRID RING
R 604
56K
R 605
56K
R 606
180~
V 602
2C40/446A
PLATE CAP
C 608
≈50 mmf
C609
40 mmf
C 609
1-3 mmf
L 604
J 604
TO MIXER POT

Original unmodified schematic of the first 2 rf stages of the 46ADT unit.

with, but as stated earlier, our best method turned out to be actual "on the air" signals, coming from either K5JHG, located about 175 miles distant, or from W5HPT, located 40 ground miles away. On both these test signals, the antenna was nulled for a very weak signal in those cases when the band was treating us well. On other occasions, when signals were naturally weaker, the nulling process was not always necessary on the 175 mile circuit. Both of these stations possess automatic "V" wheels and they would graciously put their transmitters on the air for extended periods while the various pre-amplifier combinations were tried. Ordinary 432 mc signal generators were of little value after one was in the ball park, as


ORIGINAL
+250 V SUPPLY
OMIT C601, C602
L601 LINE
ADJUST FOR PROPER PLATE VOLTAGE
39~
1W
OUTER SHELL
416B
J 601
P11
P12
(RCVR ANT)
70 TO 105 v
C 604
C603
40mmf
C 605
1-3mmf
L602
PLATE LINE UNCHANGED
J 603
OMIT C606, C607
L603 LINE
39~
1W
OUTER SHELL
416 B
ADJUST FOR PROPER PLATE VOLTAGE
70 TO 105 v
C608
C609
40mmf
C 609
1-3mmf
L604
PLATE LINE UNCHANGED
J 604
TO MIXER POT
RFC 1-4 - OHMITE Z-460 (2 μh)
12 TURNS #22 ENAMELED
CLOSEWOUND ON 1/8" FORM
FILAMENTS
RFC 1
RFC 2
1000
RFC 3
RFC 4
1000
5.0 TO 5.3 V A C
DO NOT USE
2
3
CATHODE
HEATER
1
4
HEATER
416 B
BOTTOM VIEW

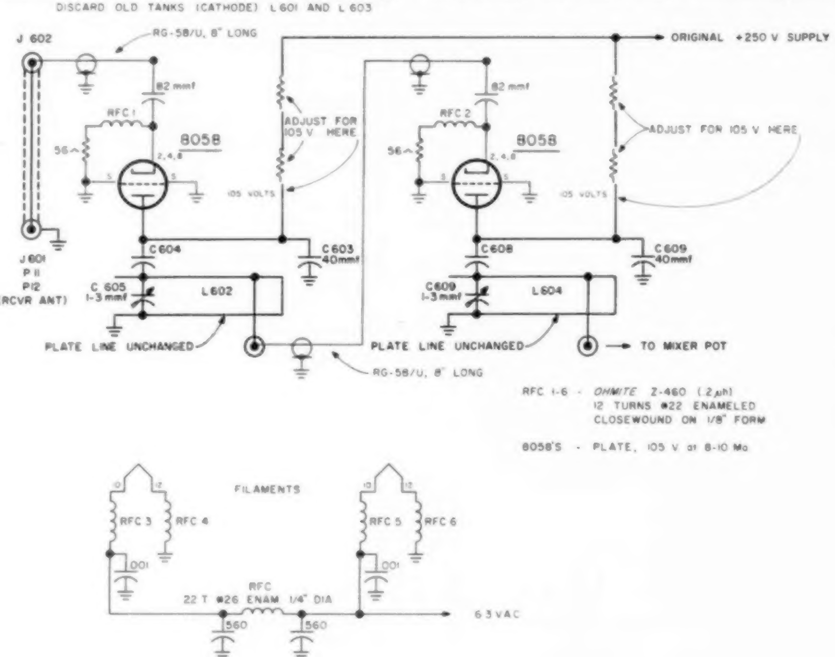
Modifications in red of original circuit to use 416B type tubes.

the signal could never be counted upon to completely arrive via the antenna. These out-of-town signals have only one way to arrive and comparisons were easily made with front-end tuning and tap adjustments easily detectable.

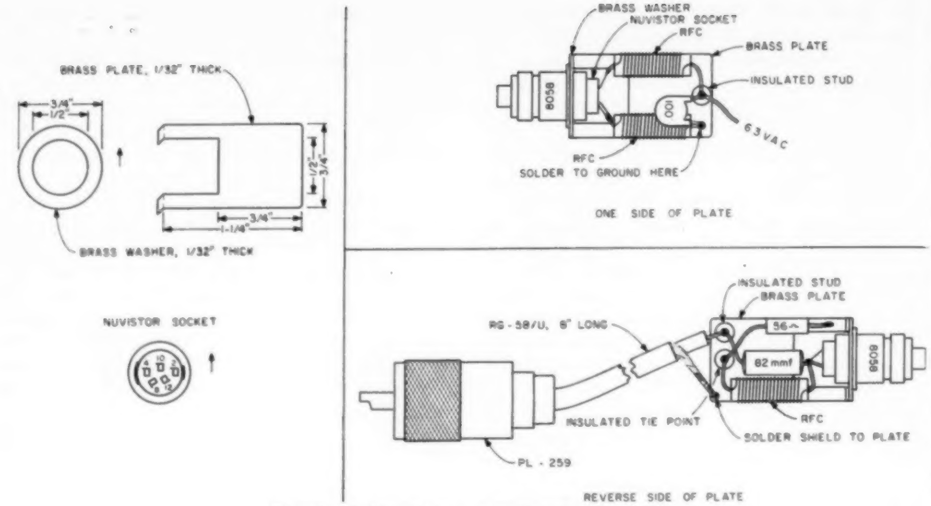
This is admittedly not a very scientific approach, I suppose, but unless one can borrow hundreds of dollars worth of test gear to do the job, this practical S/N method just described will certainly work, and really, all this noise-figure business simmers down to just how good or bad our S/N ratio actually turns out to be on that QSO. At least, this "bonehead" method takes in the antenna and transmission line during the tests—something a noise generator can not very well do. It was definitely found that the proper time to compare anything in the way of rf amplifiers on 432 mc, was when the band was poor—not when the band was hot. Anything works then, and comparison is difficult with extremely strong signals.

Now about voltage and air on the 416B's. As far as electrode voltages go, this unit using the 416B tube was operated at reduced heater and plate potential. The heater voltage was set at from 5.0 to 5.3 volts ac, and the plate voltage was adjusted from 70 to 105 volts dc. At these values, it was found unnecessary to provide air on the seals of the 416B's, even though the cavity construction bottles up the tubes pretty much. All tubes tried worked well and the average plate current with cathode resistor values of 39 ohms, was on the order of 4 to 6 ma.

Increasing the heater voltage to 6.3 volts ac, and the plate voltage to the recommended maximum of 250 volts dc, did not make any useful difference in the received S/N ratio. Using such increased voltage will necessitate air blowing on the tubes. As previously stated, this may not be the ideal way to measure, but invariably whenever a weak signal was received with the lowered electrode voltages, raising the heater and plate voltage did nothing at all in a practical way of helping the received signal against received noise. Conversely, with the higher voltages and air on the tubes, the received signal was nulled by the antenna to where it was just copyable (CW)—then decreasing the voltages did not put the signal under the noise as might be expected. K5JHG also made this type of test and reports similar results. Only when one gets ahold of a really "flat" 416B does increasing the volt-


DISCARD OLD TANKS (CATHODE) L601 AND L603
J 602
RG-58/U, 8" LONG
82 mmf
RFC 1
56~
8058
2, 4, 8
5
5
ADJUST FOR 105 V HERE
105 VOLTS
C604
C603 40mmf
J601
P11
P12
(RCVR ANT)
C 605 1-3 mmf
L602
PLATE LINE UNCHANGED
RG-58/U, 8" LONG
ORIGINAL +250 V SUPPLY
82 mmf
RFC 2
56~
8058
2, 4, 8
ADJUST FOR 105 V HERE
105 VOLTS
C608
C609 40mmf
C609 1-3 mmf
L604
PLATE LINE UNCHANGED
TO MIXER POT
RFC 1-6 - OHMITE Z-460 (.2 μh)
12 TURNS #22 ENAMELED
CLOSEWOUND ON 1/8" FORM
8058'S - PLATE, 105 V at 8-10 Ma
10
12
FILAMENTS
RFC 3
RFC 4
.001
RFC 5
RFC 6
.001
RFC
22 T #26 ENAM 1/4" DIA
560
560
6.3 VAC

Modifications in red of original circuit to use the 8058 Nuvistor tubes.


BRASS PLATE, 1/32" THICK
3/4"
1/2"
1/2"
3/4"
3/4"
1-1/4"
BRASS WASHER, 1/32" THICK
NUVISTOR SOCKET
4
10
2
8
12
BRASS WASHER
NUVISTOR SOCKET
RFC
BRASS PLATE
INSULATED STUD
8058
100
6.3 VAC
RFC
SOLDER TO GROUND HERE
ONE SIDE OF PLATE
INSULATED STUD
BRASS PLATE
RG-58/U, 6" LONG
56Ω
82 mmf
8058
INSULATED TIE POINT
RFC
SOLDER SHIELD TO PLATE
PL - 259
REVERSE SIDE OF PLATE

Details of dimensions to construct the 8058 brass adaptor plates.

ages help the situation. As long as the tubes were drawing from 4 to 6 ma of plate current, the results were always the same as far as a practical QSO was concerned. No doubt the transconductance is lowered with lowered electrode voltages, but as stated earlier, the 416B is a pretty good tube, even working under such conditions.

Other questions were raised during the testing of this unit and one of these was the proper way to couple in with the antenna to the cathode element of the 432 mc tanks modified for the 416B tube. Checking the specs of the tube, it was found that the input capacity of the 416B is about 7.5 mmfd as against the 2.8 mmfd of the 2C40/446 type. Of course this will alter the original tuning characteristics and input impedance, and in an effort to get some kind of an answer, various tap positions were tried, starting at the ground end and working up towards the cathode point. Again using the 175 mile distant test signal and with the antenna nulled for the weakest possible CW

Table of tubes that might be available to 432 Mc hams

Tube Type	7768	416B	2C40	2C43	8058	6299	7077
Input capacitance in pf	6.0	7.5	2.8	2.8	6.0	3.5	1.9
Output capacitance in pf	.025	.0095	.02	.02	.046	.015	.010
Grid-Plate capacitance in pf	—	1.25	1.3	1.7	1.3	1.7	1.0
Transconductance in umo	50,000	50,000	5100	8000	12,400	15,000	10,000
Amp. Factor	225	300	36	48	70	115	80
Plate Resistance ohms	4500	6,000	6,860	6,000	5,600	9,600	9,000
N/F	4.5 db at 425 mc	3.0 at 400 mc 7.0 db at 1,300 mc	—	—	6.5 db at 450 mc	5.5 db at 450 mc	5.5 db at 450 mc
Freq. rating	—	To 4,000 Mc	To 3,370 mc	To 3,370 mc	To 1200 Mc	To 3,000 mc	To 1,200 mc

— Means unknown

signal, it was found that nothing was gained by tapping down the cathode lines towards the ground end. Invariably, the best S/N input coupling point was found to be right at the rf cathode connection of the tube. It is possible that a small variable capacitor inserted in the antenna lead may help in some cases, especially if some type of interference or spurious signal is present, but suca and arrangement really did nothing on the particular antenna and transmission line used at this location. If for some reason, it appears advisable to isolate the antenna, a 50 mmfd or more capacitor can be left in series with the antenna lead, but the system should be checked with and without the capacitor to determine if it degrades the S/N ratio.

Should the vswr of the antenna-transmission line combination not be of the best, a re-entrant type of 432 mc resonant cavity will help in some cases.* This is inserted between the transmission line and the input to the 416B stage and could assist in offering the proper type of load to the input tube.

Under these conditions, then, it would appear that a broadly resonant 432 mc cathode circuit is about as good as one can do. As soon as the antenna is coupled in, attempts to actually tune such a broad input circuit with a small capacity element are of no avail.

Modification to 416B's

The photograph showing the 46ADT cathode tanks will reveal the changes to do the job. First off, the right hand tank is the unmodified component and it can be seen along with the original 446B tube in place in its plug-in-assembly. The tank on the left is the new 416B arrangement. This modification will necessitate a socket capable of accepting the 416B tube, which you will have to acquire along with the tube and presumably from the same source—and this new plug-in arrangement is to be made the same total length of the right hand unmodified unit. A piece of ¼" copper tubing with the end slit is used to make the difference in total length of the structure and will fit into the contacting fingers of the 446B receptacle. All the necessary rf chokes, cathode resistors, etc. can be fitted in the inserting socket shell as formerly.

Comparing further the two tank pots, it may also be seen that the silver-plated contacting fingers have been bent inwards on the left hand unit to perform a snug fit when the 416B tube is plugged in, and these fingers of course engage the rf cathode shell of the tube. Other changes will be the clipping out of the small

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* See **QST**, February 1961, page 65.

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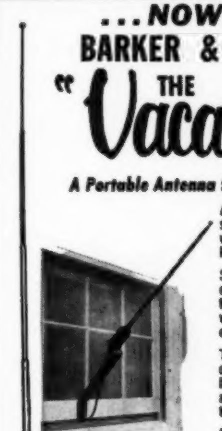

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JAFFREY, N. H.

2.0 mmfd ceramicon capacitor from the right hand unit, and the elimination of the two original cathode tuning discs, since the increased input capacitance of the 416B tube renders these unnecessary. Actually the left hand tank shows the variable disc still in but screwed back as far as possible. It is unnecessary and was later completely removed.

The last change concerns the input coupling tap. In the right hand unmodified tank, the antenna is tapped in close to the ground end of the cathode line. In the modified left hand unit, a new opening is drilled in the outer cylinder and the antenna coax input is secured to the rf cathode end of the line, as per the earlier discussion on the subject.

After these changes, the unit is rebolted to the chassis, power applied and plate circuits tuned. Nothing whatever is done to the output plate circuit located underneath the chassis. A slight returning of the plate control is all that is required. The 46ADT may be tested with this one modified rf tank or, if one desires, both rf stage tanks may be modified at one time and then rebolted to the unit for trial. Be sure to adjust the resistors in the plate circuit of the unit to produce the newly lowered plate voltage for the 416B's. Also take means to reduce the heater voltage on the two tubes to the lowered value previously given.

Results

A unit of this sort, using the two modified cathode tanks of the 46ADT was tested on a commercial broadcast STL link operating at 450.15 mc, ahead of a commercial GE receiver which used an 6AJ4 rf stage. The results were remarkable. A gain in excess of 20 db was expected and was achieved, but the improved S/N ratio of the received signal was impressive indeed.

Several hundred kilocycles of the band can be tuned before readjustment of the plate tuning is required. All in all, considerable improvement of the 416B's over the 446's will be immediately apparent.

Modifications Using the 8058's

Should the nuvistor 8058's be available to you and it is desired to utilize this tube type, proceed as follows:

First off, discard the two cathode tanks entirely. On second thought, do not discard but keep around for a quick comparison using the just modified 416B scheme. Merely unbolt from the 46ADT chassis. If you chose to disregard the 416B route, the original 446B tubes and tanks can also be bolted back and tried at any time to get a comparison with the new 8058's.

W5QOA of Dallas dreamed up the following method for a simple and effective mechanical mounting to replace the 416B's or 2C40A's in the 46ADT. The idea here will be to construct a couple of adapters which will mount the 8058's and their necessary component parts and these adapters to plug into the plate circuit chassis holes left vacant by the removal of the two cathode tanks (L-601 and L-603). Two photographs are shown that should cover the details rather well. One photo shows the adapters before plugging in, and the other photo shows the adapters plugged in and operating.

To build the adapters, refer to the sketch showing details of dimensions. A couple of pieces of flat brass stock, 1¼ x ¾ inches and about 1/32" thick should be fashioned, as per the sketch, to mount the various components. These plates will then be soldered to brass rings or washers carrying proper dimension to allow the nuvistor sockets to be mounted therein.

The three necessary rf chokes, two capacitors and one resistor will all mount on each brass plate. RF input to the stages will arrive via a piece of RG-58/U coax cable about 8 inches long. Ordinary PL-259 type UHF plugs are used to connect to the chassis connectors of the 46ADT, as were the previous used tubes. Insulated tie-points on the brass plates provide means for mounting the parts.

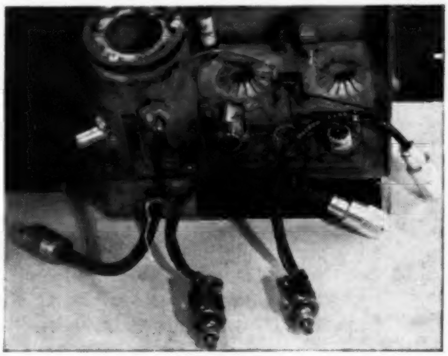
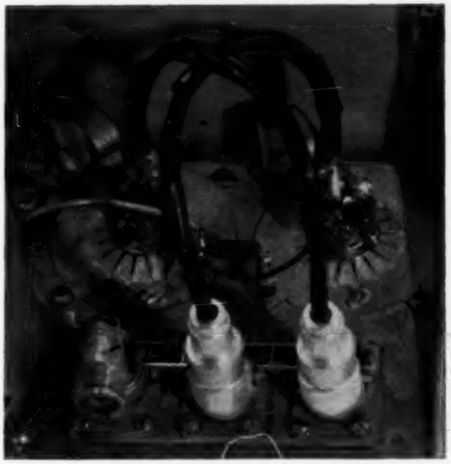


Photo showing the 8058 adaptors before plugging in the 46ADT chassis.
The two brass plates carrying the necessary components and the nuvistor sockets are visible. Also the silver-plated fingers on the grid grounding discs on the chassis can be seen to be bent upwards thereby effectively grounding the adaptors when they are plugged in.
The rf coming into the 1st stage is via the 8 inch length of RG-58/U and the rf coming into the second stage is via the same sort of deal.
The mixer in this photo is not used. This was to test the 2 rf stages only.
A couple of spring brass clips mounted on stand off insulators (up close to panel) are used to hold down the adaptors when they are plugged in.



This photo shows the 8058 adaptors plugged into the 46ADT chassis.
The silver-plated fingers of the grounding disc grounds the adapters (which grounds the grids of the 8058).
The spring brass clips or straps hold down the adapters firmly.

The photograph showing the adapters unplugged will also reveal how the silver-plated fingers of the grid grounding discs on the chassis have been bent upwards a bit to firmly engage and ground the adapters holding the nuvistors sockets. A couple of spring brass strips mounted on the tops of the stand-off insulators are used to hold firmly down the adapters into the chassis holes. No shielding between the two 8058 stages will be necessary. Everything is stable. The two leads taped to the RG-58/U pieces of coax are the heater leads. No changes are necessary in the plate lines L-602 and L-604. The 8058 plate caps are the same diameter (¼") as the 2C40's or the copper tube extensions of the 416B's.

The series resistors in the plate supply leads should be chosen to allow 105 volts to feed the 8058 plates. Each tube will draw approximately 10 ma. The heater voltage should be the full 6.3 vac. No air is necessary on the tubes.

After the adapters are plugged in and power applied, retouch the plate tanks L-602 and L-604 for resonance and this will complete the job. The 8058's appear to be slow heaters, so it would be well to allow a few minutes warm up time to take full advantage of the capabilities of the tubes.

These are smooth working bottles and should have quite long life. No difference in performance has been noted after more than six months service. The RCA tube manual lists the N/F of the 8058's at 450 mc as 6.5db. The only reference to noise figure of the 416B's at this frequency was furnished by W5LUU of San Antonio as 3.5 db. This was from an article in RCA Review for December 1958. To repeat; No practical difference could be noted between the two rf stages of 416B's and the two stages of 8058's. A listing of several types of tubes that are more or less available to UHF enthusiasts are listed. These are tabulated for rather rough comparisons and the information was collected from here and there. Additions or corrections to the list would be welcome.

Mikes, Handsets, Phones, Speakers

Gerry Stephens W9SLM
RR 2
Sheldon, Ill

The following Specs were compiled to aid in the selection and use of various pieces of SURPLUS equipment.

Handsets

Type	Cord	Conductors	Plug	Remarks
TS- 9	9 ft.	3	terms	Unit includes PTT switch. Part of telephone EE-8.
TS-10	6 ft.	2	clips	2 sound powered phones in parallel. Impedance is 350-600 ohms. No PTT.
TS-11	6 ft.	4	PL106	Cord equipped with built in rf coil with PTT switch. Part of SCR-195.
TS-12	9 ft.	3	terms	Similar to TS-9 except has hanger to hook on box. Used with EE-91.
TS-13	5 ft.	4	PL-55 PL-68	Similar to TS-11 but has 750 ohm res.
TS-14	5 ft.	4	PL-204	Similar to TS-9 except no PTT switch. Part of SCR-561.
TS-15	5 ft.	4	PL-55 PL-68	Similar to TS-13. Different SW and no resistor. Part of SCR-300.
Type L	4½ ft.	2	——	Similar to TS-10 except impedance is 350 ohms.

Loudspeakers

Type	Impedance	Remarks
LS- 1	——	4" PM type, part of BC-603.
LS- 2	6	6" PM type in walnut cabinet. Part of SCR-13.
LS- 3	8000	6" PM type in 8 x 8 steel box. Part of SCR-299.
LS- 6	——	4" PM type with baffle and horn. Part of PA-4.
LS- 7	4000	4" PM type with input trans. 3 ft. cord.
LS- 9	250	Similar to LS-3 except lower impedance.
LS-11	250	Similar to LS-7 except lower impedance.

Mikes

Type	Res or Imped.	Plug	Remarks
T-17	60	PL-68	Hand held carbon, with PTT switch.
T-21	——	——	Condensor type, with 2 stage preamp built in base. Part of GR-3.
T-24	60	PL-106	Carbon mike, Part of headset SCR 194-195 and 543.
T-26	60	PL-58	Commercial telephone type carbon, with arm. Part of SCR-197.
T-30	120	PL-291	Carbon throat type, 2 units in series on neck piece.
T-32	40	——	Carbon mike on desk stand with PTT sw. Part of SCR-188A.
T-34A	200	PL-179 JK-26	Magnetic type, MC-233 mike. Part of SCR-522 and SCR-542.

T-35	75	PL-51	Similar to T-26. Part of chest set TD-1.
T-36	50	——	Carbon type with PTT SW. Part of PA system PA-4.
T-38	40	PL-58	Carbon mike with PTT SW. Part of SCR-197.
T-42	——	——	REPLACED by ANB-M-CL.
T-44	200	PL-179 JK-26	Magnetic type for use in oxygen mask. Part of SCR-522 and SCR-542.
T-45	60	PL-291	Carbon type, anti-noise lip mike.
T-50	21,000	Amphenol MC-3M	Moving coil type with PTT switch. Part SCR-299, SCR-300 and SCR-499.
ANB-M-C1	60	PL-291	Carbon type mike MC-254, may be used in T-17 and T-30. Replaces T-42.

Headsets (Phones)

Type	Imped.	Plug	Remarks
P-11	24 K	PL-5	Double receiver headset.
P-12	24 K	PL-5	Double receiver headset, will replace P-16.
P-13	512	PL-51	Double receiver headset with cushions.
P-14	24 K	PL-5	Double receiver headset with cushions. Part of SCR-189, 190, and 199.
P-16	24 K	PL-5	Similar to P-12 except has longer waterproof cord. Part of SCR-163.
P-18	24 K	PL-55	Similar to P-16 except different plug.
P-19	24 K	PL-55	Similar to P-14 and P-18 except has PL-55 plug and MC-114 cushions.
P-21	24 K	PL-55	4 Receivers on 2 headbands, one unit each headset in series. For 2 operators to listen to 2 different channels.
P-23	8000	PL-55	Double receiver headset with MC-162 cushions.
HS-16A	520	HB-1	Double receiver headset, used with code practice equipment.
HS-18	8000	PL-54	Fits crash helmets. 2 receivers with cushions. Replaced by HS-30 and HS-38.
HS-20	470	PL-55	Single receiver headset. Part of TG-5A and TG-5B.
HS-22	8000	PL-55	Double receiver headset, with cushions. Part of SCR-194.
HS-23	8000	PL-54	Double receiver headset. Replaced by HS-30 and HS-33.
HS-24	512	PL-58	Sound-powered type double receiver with cushions.
HS-29	256	PL-55	4 rcvrs on 2 headbands, used in DF installations.
HS-30	256	none	Double rcvr insert type. With ear inserts M-300.
HS-33	600	PL-354	Double rcvr headset with cushions MC-162.
HS-38	600	PL-354	Double rcvr for use in Air Corps helmets.

(W2NSD from page 4)

ers attached and be tuned up, plus hundreds of other major and minor details. As I was brooding over the amount of work to be done before the contest and my lack of time to do it, a couple fellows from the Waltham Radio Club dropped in and offered to set everything up in exchange for using the station during the contest. It was a deal.

Later on I hope to have our set up on the Mountain too, furnishing a TV signal of good strength nightly down through New York and New Jersey. We also expect to be set up on wide band FM on six, two and 420 mc. If we have enough visitors to help with hooking things up and operating we should keep the east coast fairly busy this summer on VHF's.

The Institute

While at the Dayton Hamvention I gave a talk about the Institute of Amateur Radio, explaining the basic reasons for its founding. I've expanded a bit on this talk and it will be found on page 92. One of the values of the Institute is that it puts pressure on the ARRL to do things that it otherwise might avoid. The sudden cooperation shown in the Santa Barbara and Denver legal cases when support was offered by the Institute are cases in point. Everyone has gained as a result of the Institute action.

Membership in the Institute is $10 per year . . . every cent accounted for and spent carefully for the benefit of amateur radio.

ARRL Board Meeting

The directors and officers of the ARRL gathered at Newington on May first. You'll read it in general in the June QST and in more particular in the extra fine print in July. Perhaps I can save you some time. Of the 52 motions placed before the board 47 were carried *unanimously,* two died of no seconding, one was withdrawn, one was tabled and *one* received one dissenting vote. Fabulous performance gentlemen. I sincerely hope that

(Turn to page 91)

Regulated Power Supplies

Jim Kyle K5JKX
1236 N.E. 44th St.
Oklahoma City, Okla.

As SSB grows in popularity, more and more of us are becoming exposed to regulated power supplies—an item once found only in the very well equipped laboratory. But not too many of us are actually familiar with just how these devices work, and the available literature does little to lift the fog.

Which is, in its way, no small pity—since the regulated power supply is a quite handy device for many purposes other than controlling screen voltage on a high-power linear! Typical characteristics of a good electronically regulated supply include the ability to set output voltage to whatever you want (within reason), fantastically low ripple (usually meassured in millivolts), and exceptionally low output impedance. These characteristics make such supplies almost perfect for VFO use, low-level audio, and of course general experimentation where a variable voltage is needed.

The one thing, apparently, which makes a regulated supply a bit difficult for many people to fully understand is simply the way in which they are usually drawn, and the unfamiliar terminology employed in talking about them. Let's start from scratch, building one up as we go, and see if we can't lift the fog.

The starting point is the circuit shown in Fig. 1; as you can see, it's an ordinary cathode follower, but is dc coupled throughout. It's almost obvious that the voltage across RL, denoted on the drawing as Eo, will be equal to the voltage applied to the grid multiplied by the gain of the stage.

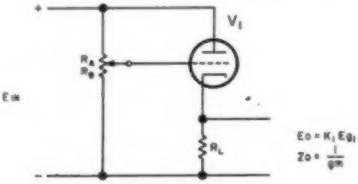


FIGURE 1

Cathode-follower "variator."

Cathode-follower gain, of course, is always less than one. A close approximation to the actual gain figure may be obtained by calculating the gain the tube would have under the same operating conditions but with the cathode resistor in the plate circuit instead, then using this gain figure in the formula: gain/(1 plus gain). The result, which will always be less than 1, will be the gain of the cathode follower. If "conventional gain" is as high as 9, cathode follower gain will be at least 0.9.

The circuit of Fig. 1 allows us to set the output voltage to almost anything we want, within limits. Since the tube gain will always be less than 1, obviously no setting of the grid pot will let us get more voltage out than we put in. Similarly, since the tube cannot be cut off by its own plate current, output voltage can never drop to zero. However, if we assume a constant gain of 0.9 for the tube and adjust the resistor from top (Ra equals zero) to midpoint (Ra equals Rb), and at the same time assume a 300 volt input, we can see that with Ra equal to zero we get an output of 270 volts, while with Ra equal to Rb we get an output of 135 volts.

Note that we are talking about *voltage* rather than power; this has an important additional effect. If our tube V1 can handle, say, 100 ma, we can control the voltage of this 100 ma current with a tiny replacement-grade volume control which by itself couldn't handle more than 5 to 10 ma!

Since this circuit, as shown, allows us to *vary* the output voltage at will we've dubbed it a "variator." However, it also provides a measure of regulation at the same time. Let's see how this can be:

You will notice that the output voltage is

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taken from a cathode follower circuit. One of the major characteristics of a cathode follower is its low output impedance. This, in turn, is a way of saying that changes in load have little effect upon the output voltage of the cathode follower. But that last statement also describes a power supply with good regulation!

One of the more professional ways to measure or specify the regulating ability of a power supply is to specify its output impedance. So far as direct current is concerned, most ordinary supplies have fairly high output impedance. A voltage drop of 100 volts between no-load conditions and 100 ma drain represents an output impedance of 100/0.1 or 1000 ohms. But in practice, this would be a pretty good HV supply!

The output impedance of the cathode follower, on the other hand, is approximately equal to 1 divided by the tube's transconductance. If the gm of the tube is 4,000 microhms, the output impedance would be 1/0.004 or 25 ohms. This is only 1/40 as great as the ordinary supply—which means 40 times better regulation.

But, though the simple circuit of Fig. 1 does provide adjustable output voltage and a

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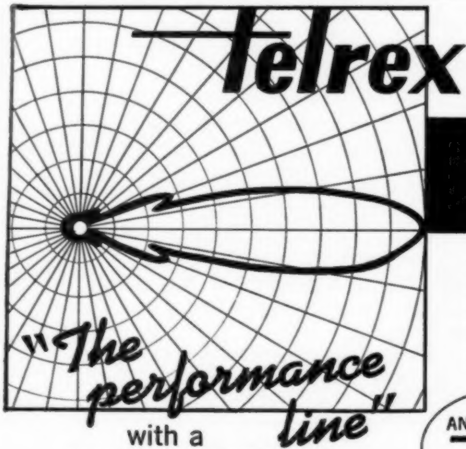

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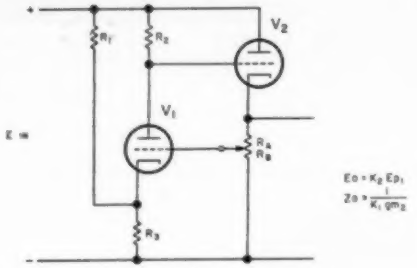

FIGURE 2

Transforming to become automatic "variator."

measure of regulation, it's not a true electronically regulated supply. Let's make it a little more automatic, and progress down the road to the fully regulated version.

A moment's thought will show you that the variable resistor made up of Ra and Rb in Fig. 1 could be replaced by a fixed resistor in series with a vacuum tube; variation of the tube's grid voltage would then change the effective value of Rb, and the result would be an effect identical to twisting the pot.

Fig. 2 shows how this substitution is made. V1 is substituted for Rb while R2 replaces Ra. The divider made up of R1 and R3 is a "stiff" bleeder designed to hold the cathode voltage of V1 at an approximately steady value. RL is now a pot instead of a fixed resistor as in Fig. 1, allowing us to set the standing grid voltage on V1 to any value we wish.

The output voltage, Eo, is still equal to the grid voltage on V2 multiplied by V2's gain; since the grid of V2 and the plate of V1 are tied together, any change of voltage on the grid of V1 will cause a corresponding change in output voltage.

But since an amplifying stage (V1) is involved, the direction of the change will be reversed. If V1's grid goes slightly positive from its starting value, current flow in V1 will increase, thus lowering the voltage at V1's plate and V2's grid, which will in turn reduce the current flow through V2, which *reduces* the positive voltage across Ra/Rb, minimizing the change in voltage at V1's grid (which started the whole chain).

This is a classic example of error-correcting feedback; any external action which tends to change the output voltage causes the feedback chain just described to become active, and the result is that the actual change in output voltage is held to a minimum.

The purpose of R1 and R3 holding the cathode at a fixed positive voltage is to provide a wider range of control. If the ratio of R1 and R3 is such that cathode voltage is, say, 105 volts, then the grid voltage set by Ra/Rb can vary either side of 105 volts. The net grid-cathode voltage, which is what determines current flow in V1, will be either positive or negative, depending on which side of 105 the grid voltage lies.

If the grid is at 100 volts, the net bias would be −5. Let's assume that this is the design point, and that V1 allows 1 ma of current to flow at a bias of −5. Let's also assume that we want an output voltage of 200, and that the gain of V2 is 0.9. Ein will be 350 volts.

For the output voltage to be 200 with V2's gain set at 0.9, we know the voltage at V2's grid must be 222¼ volts. For the grid voltage to be 222¼, we must drop 127¾ volts in R2. And we assumed 1 ma of current flow in V1 at the design point. This means that R2 should be 127,750 ohms; either a 120K or a 130K resistor would be fine.

For the voltage at V1's grid to be 100 when the output is 200, obviously Ra and Rb should be equal.

Now let's see what happens, since we didn't quite hit the proper value for R2 for practical purposes. If our regulation is working properly, the output should *still* be at 200.00 volts.

We start with 350 volts in, 120K at R2, and 1 ma of current through V1. This gives us 230 volts at the grid of V2, which we then multiply by 0.9 to get 207 volts out. Since Ra and Rb are equal, half of this 207 volts or 103.5 volts shows up at the grid of V1.

Subtracting V1's fixed cathode voltage of 105 volts from this 103.5 volts gives us a net grid bias on V1 of −1.5 volts instead of the −5 volts which fixes current through the tube at 1 ma. With less than half the bias, the tube's plate current starts to rise. But as it increases, the voltage drop through R2 increases also, reducing the voltage at the grid of V2 and consequently increasing the net bias.

For example, at the instant that V1's plate current is 1.01 ma, the drop through R2 is 121.2 volts, which leaves 228.8 volts at V2's grid. This makes the output voltage 205.92; V1's grid voltage becomes 102.96 volts, and the net bias on V1 is (102.96 − 105) or −2.04 volts. The 10 microampere increase in plate current has increased the net bias by 0.54 volts.

As the plate current continues to rise, the net bias rises with it; when plate current is 1.06 ma, the drop through R2 is 127.20 volts which leaves 222.8 volts at V2's grid. Resulting output voltage is 200.52, which results in a net bias on V1 of −4.74 volts. This value is very close to the design point; in practice, the plate

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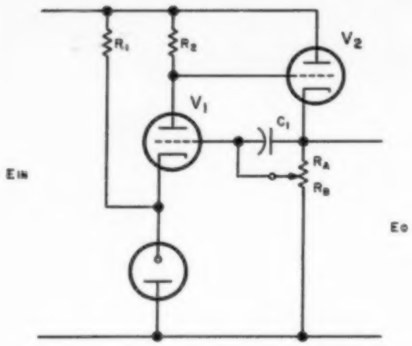

FIGURE 3

Two changes make it a regulator.

current would probably rise on to 1.06458 ma and give an output voltage of 200.01. For all practical purposes, the regulation is complete.

However, even the "automatic" circuit of Fig. 2 is not a fully regulated supply although it does regulate against any changes in *load*. If the source voltage rises by 10 percent, the output voltage will follow by the same percentage, because the *reference* used to determine net bias voltage on V1 is only a simple voltage divider.

Replacing R3 with a VR tube, to hold the reference voltage constant regardless of changes of line voltage or anything else, turns the circuit into a fully regulated supply. The change is shown in Fig. 3.

Another change is also incorporated in Fig. 3—the addition of capacitor C1. The purpose of this capacitor is to insure that any instantaneous change of output voltage (such as an ac signal or ripple on the line) goes into the correction loop at full strength rather than being attenuated in the voltage divider Ra/Rb.

The two changes together make the power supply output impedance virtually a short circuit so far as ac is concerned. If the output impedance of V2 alone is 25 ohms, and if V1's gain considered as a separate amplifier is 100 times, the output impedance of the circuit of Fig. 3 will be 25/100, or ¼ ohm! Even lower output impedances are attainable by using higher-gain amplifiers at V1; a super-gain cascode with gain of 2,000 here would result in output impedance of 0.0125 ohm.

In case you happen to be familiar with "conventional" feedback amplifiers, Fig. 4 is the circuit of Fig. 3 redrawn to emphasize the similarity with a feedback amplifier. Normally, the "amplifier" has no signal to amplify. If anything tends to change the output voltage, the change comes to the grid of V1 through Ra or C1 and since cathode voltage is fixed by the VR tube, this change becomes a signal to be amplified.

Amplification through a grounded-cathode amplifier inverts the phase of the "signal," while the cathode follower makes no additional change in the phase. Thus the amplified "signal" is effectively subtracted from the original change "signal" in the cathode circuit of V2; just as the remainder reaches zero, both "signals" disappear. Of course, as soon as they disappear the correction stops, so that the actual result is that the change is reduced by an amount equal to 1 divided by the product of the gains of each stage.

By this point, you should have a working knowledge of the concepts employed in electronically regulated power supplies. Here's how to use it to design one for your own needs.

First, of course, you must decide what output voltage and current you want. Then pick a tube (or tubes) for V2 which will pass the required current. The key characteristics of tubes for this position are high current-handling capability and high transconductance. Low-mu triodes designed for such service, such as the 6AS7 or 6080, are recommended.

Next, add to the output voltage an additional voltage to be dropped across V2, giving it something to work with. The usual allowance for V2 is 100 volts. This determines the supply voltage you need.

Now pick a tube for V1. High gain is wanted here; either triodes or pentodes are suitable. If pentodes are used, the screen-to-cathode voltage shoud be regulated with additional VR tubes. These VR tubes can be inserted in

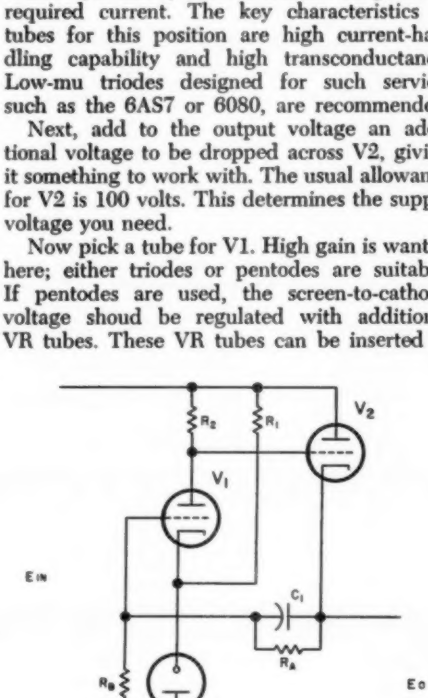

FIGURE 4

Fig. 3 redrawn to emphasize similarity to feedback amplifier.

series between R1 and the cathode in the circuit of Fig. 3.

The next step is to calculate the effective value of the minimum total load resistance for the cathode follower. This will be simply the output voltage (minimum if you're going to adjust it) divided by the maximum output current. Then use this value of R1 to determine the cathode-follower's minimum gain as described earlier.

Now divide the desired maximum output voltage by cathode-follower minimum gain just determined to fix the maximum voltage necessary at V2's grid. Also calculate the minimum voltage necessary at the grid of V2.

Knowing these two voltages, you can now pick a value for R2 which will allow V1 to be acting as an amplifier throughout the effective range. If R2 is calculated on the basis of only one output voltage, there's quite a risk of finding that you lose regulation outside a narrow range of output values!

From the characteristics of V1 and knowing the value of R2, you can quickly determine the net grid bias required on V1 at each end of the output range to produce the desired voltages at V2's grid. Subtracting these net bias values from the voltage of the cathode VR tube gives you the grid-to-ground voltage range for V1, which in turn leads directly to values for Ra and Rb. Frequently the Ra/Rb divider is made up of two fixed resistors with a comparatively small-value pot between, to give a bandspread effect; if you want to do this, calculate the resistors so that each end position of the pot gives you one of the extreme bias values.

And suddenly, at this point, you have completed the design. If you want an example to follow, go back to the sample circuit used to explain Fig. 2 and work it through.

Of course, this explanation and design procedure merely scratches the surface of the subject. A whole book could be—and has been—written about electronically regulated power supplies. But the principles described here hold true for any electronically regulated supply, and if you know them you won't have much trouble doping out any unexpected twists you come across. . . . K5JKX

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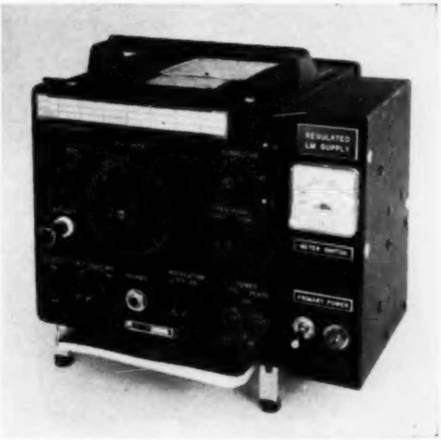
DX Titans Meet

Stuart Meyer W2GHK, on the right, talks with Gus Browning W4BPD on the left. Stu, president of Hammarlund, originated the DXpedition of the Month, a non-commercial program that has put on one extraordinarily successful DXpedition after another. It is getting a little difficult to find places to DXpedition these days because Gus has just about covered the entire earth, visiting 327 countries so far, including almost every bare rock sticking out of any ocean and well enough known for the ARRL to Classify it as a country.

Regulated Supply for the LM



Richard Arthur
1924 W. Farwell Ave.
Chicago 26, Illinois

Photo Credit: C. F. Cochran

The LM frequency meter, the Navy version of the BC-221, is still available on the surplus market and is a steal for the price being asked in comparison to the type and quality of instrument therein. John Meshna, Jr. is asking $49.00, in his current catalog, the lowest I've seen for many a moon.

The LM covers a range of 125 kc thru 20,000 kc with crystal check points throughout its range. Many have used the harmonics with accuracy up to 150 mc. One advantage over some of the BC-221's is the addition of the internal modulation which is standard on all of the LM's.

Once you decide to lay out the fifty bucks or so, you have a nice "black-crackle box" but it isn't doing you any good without a power supply. There are several approaches to the power supply problem but the only right answer is to remember that you have a precision piece of gear, so therefore let's make a decent power supply to go along with it.

As seen in the photograph, the appearance of the attached supply adds to the general design of the LM. That it simply plugs in and out for servicing is a further beauty. No electrical changes were made to the unit itself, and only one mechanical change: that of removing the center guide pin from the power input connector. This is necessary, due to the fact that the mating plug in the power supply has been drilled out, countersunk, and a 6-32 flat-head bolt passed through it and secured to a metal spacer standing off from the cabinet.

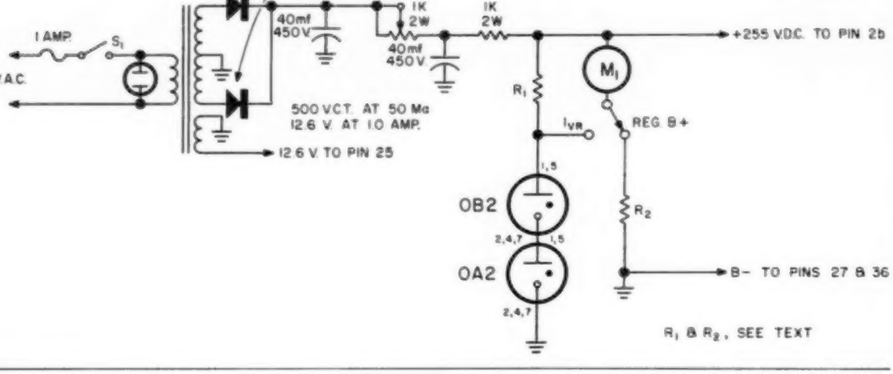
The schematic is straightforward and should not present any problems in construction. If desired, the metering circuit may be left out in order to save a few bucks; however, I felt it was an asset to be able to monitor and know that the supply was delivering a regulated B-plus of 255 vdc.

The transformer is available from GEMCO Electronics, 2415 S. Michigan Ave., Chicago 16, Illinois, for $2.69. They also carry the 1000 ohm, 2-watt control which is priced at $0.49. The cabinet is a Bud CB-628 chassis, which is steel in construction and comes with a black-crackle finish. It matches the LM finish closely. The meter is a Calrad CMO-38 which is basically a 1 ma meter with a 0-300 vdc scale. A 300K resistor (R-2) is furnished with the Calrad meter when purchased. R-1 is a shunt across the meter when the slide-switch is put in the left position, thus measuring the current through the voltage-regulator tubes. In my particular case, R-1 turned out to be 2.2 ohms to give a full-scale reading of 30 ma. This value may vary with meters depending upon the internal resistance of the movement. The reading on the meter in this

position should be about mid-scale indicating about 15 ma passing thru the VR tubes under load. This can be adjusted by varying the setting of the control mounted on the rear of the chassis.

Two five-lug terminals were mounted to the cabinet to provide connections for the two silicon rectifiers and the 1000-ohm, 2-watt resistor. The VR 7-pin sockets were mounte directly to the cabinet by forcing a 4-40 bol through the center shield of the socket fron the rear of the case. The pins of the socke were bent up to avoid shorts and provide eas in wiring. Three 6-32 × 2½″ bolts were used t secure the power supply to the LM. Clearanc holes were drilled through both sides of th power supply case to line up with the existin case holes of the LM. Therefore the long bolt pass through the power supply case and directly into the tapped case of the LM chassis One additional hole was drilled and tapped into the LM case in order to secure the rear o the power supply. A handle was added to th top of the case. The legs were made by simpl bending down the original locking brackets a full 90 degrees and attaching small rubber feet The original feature of sliding the calibratio book under the LM was retained.

Various articles have been written up on the operation and uses of Surplus Frequency Meters so I need not bother going into it at this time. All in all you will find the LM with the regulated supply to be a useful asset around the shack or bench, and a worthwhile investment.



Correction

Dear Wayne,

But like ouch! did I goof one up. I'm referring, of course, to "The Case of the Naughty Pi-Net." About all I can say in my defense is that to date not one of the guys who have written to point out specific mistakes have caught them all, but by now I'm getting a pretty good idea how mixed up it was.

Before I go into any detail, though, I have to re-emphasize that the major conclusion of that article is still correct. It's especially true in the 3.5 to 4 mc region, and on VHF, where it's the usual thing for a pi-net not to have quite enough range to take care of everything. Naturally, an antenna tuner is still the best answer, but some careful line pruning can work wonders.

Now to the biggest of the mistakes. I don't know which was the worst—getting it into my head that a full trip around a Smith Chart is a full wavelength (of course it's only a half wavelength, which in itself made all the column headings twice as large as they should have been), or trying to add and subtract impedances in parallel. To do this kind of cancellation, the impedances have to be converted to admittances for the calculations, then converted back to impedances for use.

The "circumference" error's major contribution to inaccuracy was, as I said, the change in line lengths involved. The other one, however, makes many of the numerical examples incorrect.

Still and all, even when worked out properly we find that at a point 13 electrical degrees either side of the starting point (minimum resistive impedance), the output capacitor of our pi-net operating on 7 mc must be about 1200 pf,

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0C3w	1.00	6AS5	.50	6L6g	1.00	12SC7	.50	884	1.00	5840	1.00
1B3	.75	6AS7g	2.00	6L6wgb	1.50	12SJ7	.75	927	2.50	5841	5.00
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5R4wgb	6.00	6AU6wa	1.00	6SL7gt	50	12SQ7	1.00	1274	.75	5847	3.00
5U4gb	.75	6BA6	.50	6SN7wgta	1.00	80	1.00	1625	.50	5881	1.50
5X4	.75	6BD6	.70	6V6gty	.75	83	1.00	2050	.75	5896	.75
5Y3gt	.60	6BE6	.50	6X4	.50	117Z6	1.00	5636	2.00	5933	3.00
5Y3wgtb	2.00	6BK7	1.00	6X5wgt	1.00	2E22	2.00	5647	3.00	5963	.75
6AD4	1.00	6BQ6	1.00	6Y6	.75	304TH	20.00	5651	.50	6005	.50
6AG5	.50	6B4g	3.00	12A6	.50	3B29	3.00	5670	.50	6080	3.00
6AC7	.50	6C4wa	.75	12AS7	2.00	3B24	.75	5676	1.00	6111	1.50
6AG7y	1.00	6CL6	1.00	12AT7	.50	4-65	5.00	5681	.50	6112	1.50
6AH6	1.00	6D4	.50	12AU7	.50	807	1.50	5687	1.00	6146	3.00
6AL5	.50	6E5	1.00	12AX7	.50	812	3.00	5722	6.00	6384	10.00
6AK5	1.00	6J5	.50	12AY7	.75	814	4.50	5751	1.00	6336	7.00
6AK6	.75	6J6	.50	12BH7	.50	829b	6.00	5763	1.50	6476	8.00
										7363	$20.00

many of the small receiving types listed are also available as factory seconds, pulls from new surplus, or guaranteed used tubes—these are ½ of prices listed above, tubes shipped will depend on what's in stock when your order arrives.

RESISTORS—we have all standard RETMA values in stock, carbon composition type, all color coded, long leads, new stock, 10% tol. ½ watt 10¢ ea, 1 watt 15¢ ea, 2 watt 22¢ ea, for 5% tolerance double the prices of these listed for 10% tolerance.

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hich while within range of most rigs is distinctly an bnormal situation. This is for a 2-to-1 SWR. Under the ame conditions on 80 meters, the output capacitor would ave to be 2400 pf, and it's seldom indeed that one this arge is found in a rig. So I'll stand by my conclusions ven if I did mis-chart my Smiths!

Thanks to the many fellows across the country who pointed out the circumference error, and to WB6HGC in particular who pointed out the error of adding parallel mpedances. You can stop writing nasty notes now, gang. I know when I'm wrong!

And since, as I said, not one of the gang so far has caught *all* the mistakes in my use of the Smith chart, maybe I ought to write you a piece on "How to Use the Smith Chart." Believe me, I know how now—and we could invite all the fellows who caught the Pi-Net mistakes to check it over first, as well. What say?

Jim Kyle K5JKX

Hams in the News

LOS ANGELES: Lt. General Francis Griswold sent the folowing message from a military plane over the Pacific enroute from Washington to Honlulu: "I'd like to convey to all the amateurs the Government's sincere appreciation for the yoeman service in communications they have done in the Alaskan earthquake disaster. It has been terrific."

DETROIT: Nearly one hundred Michigan mobile hams assisted in a mass polio vaccine drive. With over 900 vaccine stations and an estimated 3½ milion persons getting the vaccine, communications was of extreme importance to see that supplies of vaccine were rushed to depleted stations.

INDIANAPOLIS. Pentagon radio operators said all contact with their Alaskan military bases had been cut off for over an hour after the quake. They asked any operators who gained contact to notify the Pentagon at once.

50 - 144 - 220

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I.F.s at 7, 10, 14, 20, 22, 24, 26, 27, 28, 30.5 & 50 Mc. All with built-in power supply. 6 Meter (6CW4-6U8) $34.50 ppd. 2 meter (4-6CW4) $54.95 ppd. Best appearance and workmanship of any VHF converters. Weak-signal performance equal to or better than any other nuvistor or 417A manufactured converters. Best value by far. Write for descriptive literature.

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6 10 15 20 METERS

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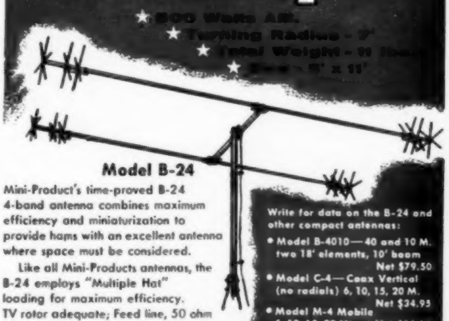
★ 500 Watts AM.
★ Turning Radius - 7'
★ Total Weight - 11 lbs.
★ Size - 5' x 11'

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Mini-Product's time-proved B-24 4-band antenna combines maximum efficiency and miniaturization to provide hams with an excellent antenna where space must be considered.

Like all Mini-Products antennas, the B-24 employs "Multiple Hat" loading for maximum efficiency. TV rotor adequate; Feed line, 50 ohm coax; SWR 1.5:1.

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$59.95

Write for data on the B-24 and other compact antennas:

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- Model C-4—Coax Vertical (no radials) 6, 10, 15, 20 M. Net $34.95
- Model M-4 Mobile 6, 10, 15, 20 M. Net $16.95

Patents pending

Mini-Products, Inc.

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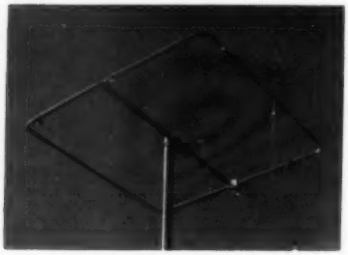
New Products



Squalo?

Yep, Cushcraft has invented a square halo. Models are available all the way from six meters right on up to 40 meters! The six and ten meter models are small enough to mount on top of a car and come with rubber suction cups for mounting. The Squalo has a 360° pattern with no deep nulls and is extremely compact. The 20 meter model, for instance, is only 100" square. This is about eight feet square instead of 32 feet long. The prices are very reasonable, the six meter model being only $12.50 and the 20 meter job $29.50. Cushcraft, 621 Hayward, Manchester, N. H.

B & W

Send a card right away for the new B & W catalog. They make a whole raft of things . . . miniductors, phase shift networks, pi-net inductors, coax switches, knobs, transmitter, linear, power supply, etc. B & W, Bristol, Penna.

Revealed at Dayton

One of the booths that was particularly hard to get into at the Dayton Hamvention was Newtronics'. The commotion had a lot to do with their first showing of their Coveya 6 beam. The Coveya is a combination of colinear, vee and yagi. Their specs say it has a 10 db gain over a dipole and 25 db front-to-back. It is gamma matched to 52 ohms and presents a VSWR of less than 2:1 over a full megacycle, which megacycle can be adjusted from 50-54 mc. The price is $39.90. You'd better take a look at this one, or send for a data sheet from New-Tronics, 3455 Vega Ave., Cleveland 9, Ohio.

Using the TS-118A/AP Wattmeter

Gordon Hopper W1MEG
75 Kendall Ave.
Framingham, Mass.

RF wattmeter TS-118A/AP is a portable load-resistor-type absorption wattmeter used for the measurement of rf power within the frequency range of 20 to 1400 mc. It is used with a selected thermocouple for power measurements, or is used without a thermocouple as a dummy load on these and lower frequencies.

The entire unit is housed in a metal case with a detachable cover and consists of the rf wattmeter, a tuning shunt, four thermocouples, three adapters, and an rf cable. There are four calibration curve charts, one for use with each thermocouple, attached to a cover which protects the meter face when the unit is not in use.

There are no operating controls on the wattmeter nor does it require any external source of power. Its meter is calibrated from 0 to 1 and indicates the output of the thermocouple. The meter reading is used to determine the power being measured and the four thermocouples cover a power range of 2 to 500 watts. The calibration charts are used to enable the operator to select the proper thermocouple.

Each calibration chart contains a K factor which are used in power calculations when used with the particular thermocouple indicated on its individual chart. This K factor is actually a representation of the maximum amount of power that each individual thermocouple is capable of handling. Each thermocouple has a C factor etched into it which is incorporated into the power measurement calculations. To measure a transmitter's output power, a simple formula is used. This formula is:

Power (watts) = K times C factor times meter reading.

An example of a power measurement is as follows:

1. Determine the transmitter's approximate power and frequency.
2. Determine from the charts the K factor for the approximate frequency.
3. Select the thermocouple whose K factor is closest to, but greater than, the approximate power. (The K factor can be equal to the approximate power.)
4. Assume that the transmitter frequency is 144 mc and that the approximate power output is 200 watts. Refer to the calibration charts and select the thermocouple whose K factor at 144 mc is greater than 200. If the approximate power is not known, use thermocouple MX-1783/U first.
5. If the transmitter output is terminated with a UHF or N type receptacle, connect the wattmeter as shown in Fig. 1.

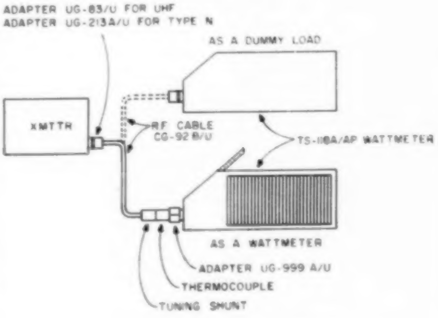


FIGURE 1

Tone Converter: dual freq. shift radio teletype, Radio Northern type 152, model 2, 110-220 V. 50-60 cy. 1 ph. O/A dimensions 17" x 3½" x 19" complete with tubes used excellent
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Reperforator-Trans-Dist. (Combo) complete in sound proof cabinet & slide out table $130.00 each
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Traps for dipoles . . . high strength . . . moisture proof guaranteed to handle a full KW.
Model KW-40 coils will, with a 108 foot antenna, provide operation on 10-15-20-40-80. $12.50 set.
For information on other models write:
FRED L. REYNOLDS W2VS, 492 Ravenswood Ave.,
Rochester 19, New York

6. Note the correction, or C factor, that is marked on the thermocouple.

7. Turn the transmitter on and tune it using its own indicators, allowing one minute for the transmitter and the wattmeter to stabilize before taking a reading. (The wattmeter will lag slightly behind any power level changes.)

8. Take the wattmeter reading which will be 1.0 or some even hundredth part of 1.0 such as 0.84.

9. Calculate the power using the formula given previously:

W = 238 times	0.960 times	0.84
(K for MX-1782/U at 144 mc)	(C factor for MX-1782/U	(meter reading)

W = 191.92

Be sure to turn the transmitter off before opening any rf connections to the wattmeter. The power reading obtained indicates the power that the transmitter will deliver to a 50-ohm resistive load. Retuning of the transmitter will be necessary when it is reconnected to its antenna system.

If the TS-118A/AP is to be used only as a dummy load, connect it to the transmitter as shown in Fig. 1. It can be used as a dummy load in a 50-ohm coaxial line in the 20 to 1400 mc frequency range. However, it can also serve as a dummy load on frequencies below 20 mc by disconnecting meter M201 at jack J202. This will prevent the high vswr from damaging the meter.

. . . W1MEG

Modifying the BC-348

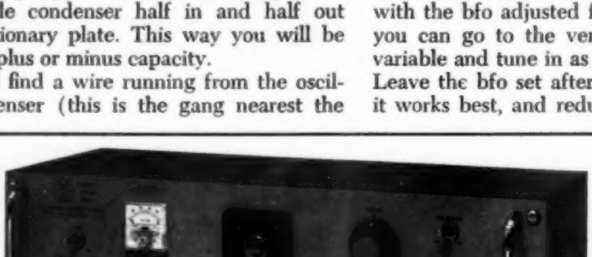
Harold Mohr K8ZHZ
5670 Taylor Road
Gahanna, Ohio

The 348 is a good stable receiver but is very hard to tune side band satisfactorily due to the tuning ratio of the dial.

First, obtain a small midget variable capacitor that has a shaft for a tuning knob. Then a 2 preferably, or not over a 3 mmfd ceramic capacitor. Remove the 2¼-inch by 6 inch metal panel that covers the rf tune sockets on the right front of the 348 panel. Remove all but one rotor and one stator plate from the small variable and mount it on the left of this panel cover. Make sure it does not interfere with anything in the tube socket compartment. You can place a small indication mark on the panel above the knob and place the knob in a straight upright position with the rotor plate of the variable condenser half in and half out of the stationary plate. This way you will be able to go plus or minus capacity.

You will find a wire running from the oscillator condenser (this is the gang nearest the center of the 348). You can solder one end of the 2 mmfd capacitor where this wire enters the oscillator coil, after you have clipped the capacitor lead wire rather short; then route a wire from the remaining capacitor lead to the stator of the midget variable. This is all there is to it.

You may notice that this will throw the dial calibration off about the width of the marker, especially on the higher bands, and if you are a perfectionist you can touch up the oscillator padders on WWV or some known standard, but be sure you leave the small capacitor with the knob in straight up position when doing this. Always leave it here and tune in the SSB or CW station the best you van on main dial with the bfo adjusted for best reception. Then you can go to the vernier knob of the small variable and tune in as easy as falling off a log. Leave the bfo set after you have found where it works best, and reduce the gain of the 348



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CONVERTER**

$199 (dual eye indicator)
$279 (CR tube indicator)
$14.50 cabinet

Audio input. Scope or dual eye indicator. Plug-in inductors for wide or narrow shift. Axis restorer & Limiter can be switched in or out of circuit, to suit conditions of fading or interference. Copies on Mark only or Space only automatically Mark hold circuit. Loop & Bias supply for optional polar relay for keying transmitter. Keying tube keys magnet. Terminals on chassis for external keying relay & scope indicator.

ALLTRONICS-HOWARD CO., Box 19, Boston 1, Mass.

if you have the gain and volume controls separated. If not, use as little gain as needed.

You will be able to listen to both sides of an SSB QSO, often by just adjusting the small capacitor. Then there is not any danger of losing the other station, as you will find you can tune most SSB signals in with AM quality by careful adjustment of this small capacitor.

Although especially designed for the BC 348, it should work as well with many other receivers.

. . . .K8ZHZ

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Pattern: 360 horizontal, variations of ± 2DB or less

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Gain: Single bay — approx. [illegible] DB over Halo

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¾ meter Model No. ABW — 420 — $ 8.95
1¼ meter Model No. ABW — 220 — $10.95
2 meter Model No. ABW — 144 — $12.95

For Further Information & Illustrations Refer to:
Page 42 September QST and Page 60 October QST

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Two Meter xmitters that use xtal mikes and carry a good punch in the audio system! Two watts (it's enough!) into the antenna with modulator and tubes, **$25.00**

Power supply for above **$12.50**—Mikes are xtal and can be had for **$7.50** ea. Units only—less all other accessories, only **$18.00**

Can supply six meter xmitters also, same as above—except over three watts. WILL put out four watts with higher plate voltage. Same prices as the two meter rigs.

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Save your money—they work fine as they are—but you CAN get cabinets if desired.

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(High Gain from page 33)

Like the previous circuit, this one makes use of an extremely high-valued plate load resistor. However, no shunt is necessary to keep transconductance up since pentodes maintain reasonable values of gm down to almost zero plate voltage.

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. . . K5JKX

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(W2NSD from page 75)

some sort of award can be made to Phil Spencer W5LDH of the Delta Division for chirping off key just for one instant at a board meeting. It has been a long time since that has happened. It's *something*.

Eight of the directors come up for re-election or replacement this year. How about it, shall we see if we can't get something in there besides a set of puppets?

OK, now let's see what the directors accomplished with those 47 unanimous votes. Hunty has been looking a bit peaked lately . . . I'll bet that handsome raise the board gave him will make up for a lot of the harassing he has been getting. The board gave the Executive Committe carte blanche to increase Budlong's "retirement" pay too. Hmmm, I understood that Bud was already getting 100% pay in "retirement," am I wrong?

Another big appropriation was $100,000 for the defense of amateur frequencies in the coming years. This is quite an appropriation . . . it is the dues of 40,000 members of the League, about one half of the members.

The hundred grand won't go very far if Hunty spends up a storm like he did back in 1959. He and Budlong represented the ARRL at the Geneva Conference that year and turned in a bill for $15,701.68, if I read the fine print on the League financial reports right. I don't like to bite the hand that has fed me (yes I do), but the dinner Bud and Hunty bought me in Geneva took care of my own ARRL membership dues for a number of years. I figure that I'm just making time payments on that dinner each year as I send in my check. Their hotel was palacial . . . the sitting room of their suit was larger than the lobby of my hotel. Nothing but the best . . . right?

Seems to me I remember their flying president Dosland over for a couple of weeks vacation. . . and didn't they pay his salary while he was taking time off his regular employment?

Shucks, there I go getting sarcastic again and I wanted to be straight forward this time. You'll have to admit that I passed up the opportunity to say something about the directors grabbing a ribbon for a dance around the May-pole. Well, I almost passed it up. I'll also not say anything about their dance around my February poll.

Seriously, is there any way that us members of ARRL can find out where this 100G goes to? If some good can be done with it, all the better fo us all . . . but we don't want it to turn into a big "fact finding" vacation fund.

. . . Wayne

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IoAR News

What is the Institute?

1. Members
2. Directors
3. Coordinators
4. 73 Staff
5. Temporary secretary: Wayne Green

WHAT IS THE INSTITUTES' PROGRAM?

1. See that our legislators and government get publicity about amateur radio via the publication of a weekly newsletter.

2. A representative in Washington, Harry Longerich W2GQY/4.

3. Support amateurs in legal battles.

4. Establish club stations in new countries.

5. Sell ham radio world wide.

6. Get information on current events to all interested amateurs and IoAR members and encourage members to make their views known to ARRL directors and ARRL HQ.

Why is there a need for the IoAR?

1. Amateur radio has no representation in Washington.

a. Other users of radio frequencies have organizations in Washington to help protect their frequencies and privileges. See 73 April 64 page 18 for details. We, who have been the constant losers, more than any other group, should be strongly represented. We've tried doing without, can we learn?

b. Other hobbies have organizations in Washington to keep in touch with the government, and protect the privileges of the members against restrictive legislation and promote positive legislation. Good examples of this are the Aircraft Owners and Pilots Association and the National Rifle Association. AOPA, being on the spot, was able to get legislation through Congress quickly when they wanted alien pilots to be able to use their plane radios while in the U. S. Look how many years we've been trying to get reciprocal licensing.

c. The ARRL HQ group has been fighting a Washington office for years. There was considerable discussion of this in 1958 at the National Convention in Washington and the main reason against a Washington Office for the ARRL at that time was that HQ was convinced that such an office would grow quickly and would eventually overshadow the Connecticut HQ, forcing everyone to move to Washington. They didn't want to move.

d. The Institute of Amateur Radio will be centered in Washington DC. Four of the nine interim directors of the Institute are in the Washington area and they are proceeding with the bulk of the organizational work from there.

e. One of the IoAR interim directors is an official representative and is in touch with the Senate, Representatives of the administration etc. The voice of amateur radio is being heard where it counts.

2. Nothing is being done to keep our own government behind us.

a. We had very little support at the 1959 Geneva Conference. U. S. delegates representing the various users of radio frequencies admitted that amateur radio was at the bottom of the list.

b. The ARRL has proposed no program whatever.

c. The Institute started in April sending a weekly newsletter to every U. S. Senator, every U. S. Representative, every state Governor and all Government officials involved with radio. This newsletter stresses the public service of amateur radio and the benefits to the country of our having a strong amateur service.

d. Government officials and Congressmen have an office to call when any problems come up regarding amateur radio. The Institute Washington representative has personal contact for all of us.

3. Little is being done to prepare for Geneva.

a. The outlook for the next frequency conference is indeed black for amateur radio at present. Educated estimates are that we will lose 40 meters plus parts of 80 and 20.

b. The ARRL has proposed no plan. It is depending on the IARU.

c. The IARU is in bad shape. It was flatly turned down in region 2 (North and South America) in April when president Hoover had no program to offer for saving our bands. Instead a separate organization was formed with separate officers. IARU region 3 (Australasia) is virtually unorganized. Region 1 (Europe & Africa) is partially organized, but may soon fall apart over lack of any program.

d. The Institute proposes to make club stations available to locals in DX countries who are trained in amateur radio by visiting DXpeditioners. This should help introduce radio to newer countries. Several manufacturers have volunteered to supply equipment for this program.

e. The Institute plans to send out an international newsletter to government officials concerned with amateur radio to point out the advantages of having a strong amateur service. All probable delegates to the Geneva Conference will also get this newsletter.

4. Amateurs fighting legal battles get little support.

a. Whenever an amateur loses a legal case involving amateur radio this sets a precident which can then be pointed to in the future wherever a similar case is in contest. It is therefore of great importance for all precident setting cases to be won.

b. The ARRL provides legal advice, but not money. Legal cases can be very expensive. W0JRQ has spent well over $1500 fighting a suit against his tower. People that moved into his neighborhood well after he had his tower up have sued him for $8000 damages to the value of their property because of the unsightliness of his tower. If he loses this case every amateur in the country with a tower would live in fear of a law suit for thousands of dollars and with a precident for the suers to point to.

c. The Institute position is that cases like this are a responsibility of all of us and that funds should be provided to help amateurs who, through no fault of their own, have to fight a suit which could hurt all of us if lost. The Institute has sent $500 to help W0JRQ with his case. We understand that this has resulted in quite a change in the ARRL position and that there is a good possibility that the League's council may now be available to help fiight the case. This is an additional benefit which wasn't planned for. With this array of support there is a good chance that the complainants may give up the case.

d. In Santa Barbara three hams have been prosecuted by the city as public nuisances to put them off the air. The entrance of the Institute into this case, we are informed, has again seen an offer of ARRL council Booth to fly out and help fight. We understand that the city, informed of this turn of events, has thought better of the suit.

e. The Institute is investigating the possibilities of providing all members with an insurance policy to protect them from suits connected with amateur radio. The Institute intends to help as much as possible amateurs with legal battles involving amateur radio.

5. There are at present no checks and balances for immence power of ARRL HQ.

a. ARRL admits that they do not represent the amateur (July 63 QST page 9, paragraph 4).

b. ARRL HQ suffers from frailities. 1) Irresponsible submission of RM-499. 2) Coca-Cola deal. 3) Santa Barbara legal battle 4) W0JRQ legal battle

c. It is much more difficult to succumb to frailties when you know that some group is watching your every move. Much more.

6. Little is being done to improve the technical standards of amateurs.

a. ARRL recognizes and decries the situation, yet has not furnished leadership.

b. The Institute proposes to establish a program of technical achievement with certificates and awards. 1) Exams to be given at hamfests and conventions under close supervision of clubs. 2) Awards for outstanding developments, break-throughs, unusual construction projects, patents, etc.

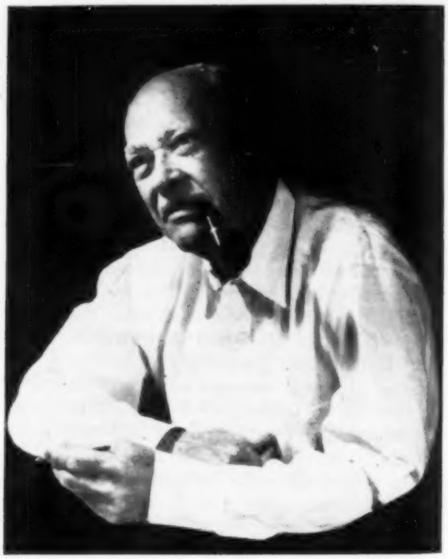
7. There is no organization program to keep commercials out of our bands.

a. Mount a full scale attack on elicit use of our bands by other services. Co-ordinate a serious effort to identify all transgressors. Lodge official complaints against them with our government, the ITU, the government of the country involved through their representatives in the U. S. and directly. Should this not get results we can muster the full strength of IoAR membership to put pressure on their government, their repersentatives in the U. S., their travel bureaus, etc. We will also let all the members of our own Congress know that the country is operating or condoning operation of transmitters contrary to international agreement through the ITU.

Interim Director W7OE

Howard Pyle W7OE. Age 66, licensed 1912, now Extra Class. Past calls: HP, MA, 7HP, 7NG, 7FT, 7OE, 7ASL, 8FT, 8RI, 8DAG. ARRL member since inception. Also member of SM, IAE; VWOA; OOTC; OTC; DeForest Pioneers; A-1 op; Morse Telegraph Club. Has had hundreds of articles published over the past 50 years plus six books, four of which are current. Retired Electronics Engineer with U. S. Gov't. Has worked as a sea-going merchant marine operator, marine coastal station operator and manager, 5 years Chief Radioman (permanent appt.) U. S. Navy, Chief Engineer several radio manufacturing com-

IoAR News



panies, manager RCA marine dept. Chicago, wholesale radio salesman, radio and later electronics engineer, U. S. Gov't. (2 depts.), Asst. U. S. Radio Inspector, Bureau of Navigation, etc. Charter and Founding member of IoAR.

Biography and Comments de K2TKN

It seems like a long time ago, and I guess it was . . .

A cousin came to spend the summer vacation. He was the same age as my brother and life became somewhat strained for me, being five years younger. This cousin was an electronics wizard, for altho only aged 12 or so, he had constructed a crystal set that actually worked.

After weeks of untold favors, cajolery, and outright bribery these two hooligans condescended to show little brother how to construct a set. A tightly wound coil of wire on a cardboard tube of well-known but unmentionable origin, manufacture of a sulpher and lead crystal, and trading him out of his spare headphone (as I recall, my soul was only a small concession in the deal) and I was the proud possessor of the finest crystal set in Kansas City that stoutly refused to utter even a faint squeal. Long weeks were spent that summer, winding and rewinding that coil, carefully scraping a path for the slide tuner to contact, all under the close supervision of this radio whiz kid. Noth'in . . . Not the faintest sound. He went back to Des Moines and school and after several months more of fruitless effort my brother let slip that that tightly wound coil of mine was bare wire while the working model had enamel insulation. After 30 years I do occasionally speak to my brother again. In spite of his perversity, the cousin went on to become W9TGL (three gorgous ladies) of pre-WW2 fame and today is a slightly tarnished BRASS HAT in the AIR FORCE who has been known to get on the air as W4WGO. After what seemed eons at the time, I recall learning the code at government expense. This consisted of religiously taking the amateur tests every time the FCC inspector came to town with his tape machine, always flunking but each time by a little less, meanwhile frantically bootlegging on 160 meter fone far into every night. To this day, I am sure that kindly inspector (MacDonald) overlooked an uncrossed T or misplaced punctuation mark to get me 65 in a row and out of his hair, or off 160, I am not sure which.

What a thrill to legally call CQ and hear an answer—Ollie W9EKJ who was clear across town was in there loud and clear. He promptly, with some knowledge of prior operation, demanded that I get off the air and quit using his call—refusing to listen to my attempts at phonetics to explain my call was plainly W9ETJ on my license and he went clear ape when my buddy George Horner, who had received his ticket that day also, called in with W9EDJ. Half the whole 160 meter was in that ruckus before the air cleared that night. Shortly after, I was intiated into the business side of this game, chasing parts at Van Sickle Radio, St. Louis for Griff W9OWD, God rest his soul. I am sure he and Walter Ashe gave more young squirts their start in this business than all the DeForrests, Sarnoff's, etc., put together. And Walter is still doing it.

Wells Chapin W9DUD was building some of the biggest and prettiest KW rigs ever known by the late '30's. I know, for he used to come into the store and buy a $1.19 17 x 13 x 4 steel chassis, they didn't come any bigger and my job was to punch out the holes he drew on the brown paper cover. Try going into the parts house today, buy a chassis and ask them to punch the holes for you (HA) and all we had in those days were Greenlee hammer punches. Thats what the part-time after school amateur kids working there were for. After working there several years, the Naval Reserve was called out and I got out of High School concurrently in early 1941. That free crystal cost me 5 years in the Navy. As I recall, I owed Griff about $3000 for parts purchased at employee discount above my wages, which he had tallied every week then written off as a dead loss. I had DXCC before I found out boys were supposed to go out with girls and had collected several Grand Island FCC QSL's for shorting out the only choke in the PWR supply on my push-pull parallel TW-150's after a W6 let slip how to get that sure fire bat of 120 cycle gargle that no DX on the low end of twenty could resist. If there hadn't been plenty of science courses and a ham as principal of the school, it couldn't have been done. In those days, OM, DX was pure work. They hadn't been Gus'ized, Danny'ized or Collins'ized and neither had we.

By 1946, an old grizzled hash-marked Chief Radio Technician was let out to pasture, after all he had been thru every radio and radar tech school they had and then several years of too many TBM-TBK, SA, SC, SQ, SG, over two hundred SJ's each with cronic problems someone had to suffer with. I was 22, but felt everyday of 100. One bright spot stands out in my memory of those days. One Christmas eve when I had the duty at the RMO 15th Naval District Panama and after finishing straightening out the bumps in the linoleum of the radio shack floor or some other highly secret technical detail transit ships demanded the base experts attend to while the crew bellied up in RioBahoo, some other disfranchised ham and I were sitting there sloppin up coffee and discussing the hell of being in DX country at such a time. This was in the radio shack of a tin-can, I believe, and there was a TBK transmitter with the filaments lit, tuned up at a full gallon on 8120 kc or such. Deciding they could only shoot you once, I let out a long slow CQ DX and signed W9ETJ. This was 1944 when we were not exactly winning the war in the Pacific and there hadn't been a legal Amateur contact since 1941. The band opened up for 20 kc either side with the ##$""&# pile-up of DX ever packed in at one time in the history of radio. For the next two hours we worked'em by the gross. There were Japs, Germans, Iti's, Russians and Allies by the numbers. On the frequency, that night before Xmas, there were just Amateurs, doing what they like best—there just wasn't any war for us for abt two hours. Half the GI's were too chicken to sign their own calls and used initials, etc.—it sounded like 75 meters the night before we got the band back after the war. Finally, someone decided this amateur bit was not the way to fight a war, and NSS cranked up on frequency and demanded identifiers which rather squelched the whole thing. At noon the next day, there were still a couple of PY's working J's for WAC on the frequency. The fact that Boyd Phelps W9BP was RMO may have helped keep in out of the brig.

By 1950, after deciding there had to be better ways of making a living than AM soap-radio engineering including owning a peanut-whistle, KXGI, and going thru the BOOM TV shop periods, I ended up a field engineer with Raytheon Mfg., Chicago. Six hundred and fifty service meetings later moved over to the Magnecord and sales. By this time, W0ETJ out of Elsberry Mo. had done fairly well on six and two. That five or six miles west of the Mississippi river sure made that an ideal location. Being the first W0 going west when six and two were new was some pumpkins, I'll tell you. There were more than numerous occasions when Dallas W9AAG, Red W9EHX, W9MUD and many other W9's in western Illinois sat there and heard W1, 2, 3, 4's calling and at times working that ### 0 just over the line. Before leaving, a 25 ft. cylindrical parabola 70 feet in the air had effectively removed about two states from the distance to the East Coast. W2AZL and W2CXY still claim I must have been using that xtal set with the bare wire coil but the 4-125's at 4 KV and 1 amp put out a fair signal after little taming, and care not to make long dashes. Don't get out your slide rule to figure out the input—that was the most legal KW ever generated to snag DX on two. If you held the key down long enough for the meters to slow down long enough to read, those 4-125's would have been walking around the ceiling of the shack.

Ten years ago, Ed W0LFE, inherited the favored W0 position and has done very well for himself, while I am in the middle of the gibbest pile of locals on VHF in the world. The band could be wide open to W6 on two from New Jersey and the call K2TKN and 10 cents would get me a bad cup of coffee under the pile-ups. There was nothing else to do but go on 1296 mc to find some elbow-room. I find there is plenty.

An old man from up the road, after looking at the 20 ft parabola and other contraptions cluttering up the QTH and learning I point these at the moon on occasion, asked "But what does the Moon say" and you know he may be right. There sure isn't much of a QRM problem.

Being a gadgeteer by nature, VHF and UHF have always fascinated me for here are vast areas of uncluttered space where an untutored amateur, by the expedient of extreme specialization and simply wanting to do something of value badly enough, can make monkeys out of the communication "experts." We've got receivers now that make their Kilobuck specials about equal to xtal sets and we have always been willing to try anything. They can't get a contract from the Gov. unless their theory looks right. We can't lose, all we have to do is play the cards. They may have been stacked in our favor up in this range of frequencies.

Below 100 mc, I am afraid it is another story. The majority of my actual operating time in the DC bands recently has been on Air Force MARS channels. If you would like to fully understand what the HF amateur bands are going to sound like shortly at the present descent levels, try copying SSB traffic on 3295 kc at 0200 Z or 7460 kc. These are military channels with the full authority of the US backing them up and this makes them open season for every raw ac crud generator in this hemisphere. Reread W4LCY article in May 73—then read it again and see that every meeting of your local beer-chowder club is devoted to actually what can be done. Let someone else win field day, for at the present rate of descent there aren't going to be many more anyway.

I am a lousy commercial—I make a living selling Cornell Dubilier products to the parts distributors that sell to amateurs. Loss of the HF amateurs bands or incentive louse-up would mean reduced HAM-M and TR-44 rotor sales. (It already has in truth.) That would only leave less than 28,000 other items for CD to sell to the distributor whose amateur sales dollars are a small part of his total. You don't seriously believe the amateur sales of Collins, Hallicrafters, etc., keep these companies in business, do you—this isn't 1938—it is pretty late in 1964. And if you don't think I know this market and how to peddle merchandise, reread the sub-liminal (free) ad built into the second sentence of this paragraph. Bill Orr and his group of old pro's couldn't have done better in QST. Which reminds me, you couldn't buy my ARRL membership for kilobucks during this hassel. I've found as a mem-I am entitled to vote now and then. It isn't for much, but few bothered in the past so who cared? I've had go-rounds with Headquarters before about raw commercialism in QST and their lack of interest in 432 mcs when we needed it most, and found them subject to the same human frailities as most. Pressure on a Director who in turn does a little desk-pounding has it's effect. I like to remember copying code practice on a one-tube blooper and the thrill of W1AW's big signal in the middle-west a long time ago, but as I have gotten older and a bit more experienced in worldly ways; I'm afraid the ARRL doesn't have the same image it once did for me. As a commercial corp., they would bumble along making large noises of extremely conservative gooble-de-gook til the first highly specialized, market and cost conscious—sales oriented competitor took them to the cleaners by the chapter and verse. The crime in this case is that *you* are going to lose forty meters and large chunks of the other HF bands while *we* try to straighten out our internal organization. Everything is new at Headquarters except the direction and point of view. The outpourings and apparent objectives seem about ten years old.

Our first preliminary organizational meeting of IoAR directors was, by necessity, in regard to immediate and extremely necessary actions and short range objectives. A great deal was said about the average amateur and what they could do, given the opportunity, to keep what they own. I didn't say much, for I was in complete agreement with what was being said. But, after the meeting, when driving home, I had a chance to sort out the multitude of thoughts proposed by this keenly and currently aware group. It suddenly struck me. . . I have never met an *average amateur*. I'm not average, and you're not either. If I was, I wouldn't admit it, and anyone that says I am is in for a very hard time. As sure as I am sitting here looking for the erase key on this mill, my ARRL director has me lumped up with all the other K2's and he tries his best to represent this image. No wonder things are in such a mess. And if this is true, the HdQtrs people must think of the average director and his views as representitive when making daily decisions that affect everyone of us . . . My God—I'd rather eat a can of worms than picture that, but it is true, and it has been going on for years.

But that is democratic government, you state. Not by a long shot, not in professional politics in modern times. We live in the best country in the world today because a finely balanced set of check and counter checks have developed at all levels, individual, ward, city, county, state, and national, keeping everyone aware of current situations and on their toes. The very intricate system of lobbying at all levels of government, from your local school board to congress, is an extremely important part of this system of government that we are justly proud of. I'll guarantee you are not first in line waiting to vote in some local or even national election, but even a hint of increased property tax will put you firmly up front pounding the desk of your alderman or town council member, etc. I've never heard of a lobby in Washington actually representing me as a US citizen, but there are hundreds of them representing in fine detail every facet of my every day action, each highly specialized in a certain field. This I can understand and now it is apparent to me how IoAR can provide an aggressive and healthy additional service to every amateur. Just keep in mind that each of us is an individual with divergent views, pet-peeves, and care-less's. If you don't think so just ask your wife—I wouldn't dare ask mine!

Let me illustrate my point. You are a paid-up member of IoAR and without your individual approval, I am a temporary director of IoAR. I am professionally employed in electronic industry, an advertizer and paid-up member of ARRL-QST and am going to stay that way. That lost about 25% of you. I think we are too little and too late and am sure we are going to lose much of our HF bands in the next few years, and think we are getting just what we deserve for lack of effort. That alienated another 50% right there. DUD just flipped. My opinions on how to clean up the HF bands are well known by some, but in particular by the FCC. My petition to them, countering the ARRL foolishness, makes operation on any mode on any HF band a privilege that must be earned by each individual amateur by personal effort to expand our knowledge of VHF-UHF, by extended occupancy thereof with state-of-the art equipment, homebrew, kit or appliance. Try to DX-country hop and keep your HF privileges under these conditions. If you think I'm kidding just forward SAS plus for duplicating cost and you can read a copy of this bomb. That eliminated most of the rest, but just to make sure, many individuals and clubs have heard me expound on why Technicians should be re-newed after the 1st five year period by formal office exam, only and that the conditional situation stinks to high heaven. Wow!

I do believe that VHF-UHF expansion is our only hope, that a few thousand experienced adult-oriented (no grandfather clause crutches) HF stations can handle 10 times the true emergency possible in the trivia current today, and would present an image to the rest of the world that would help us expand amateur radio, rather than destroy what we all love and wish to preserve, *as is now happening*. I think that the most important single quality of Amateur radio is that you transmit only if you desire, say only what you want about your views, circumstance, convictions or color and can shut off the rcvr and hit the sack at *your* convenience. There has never been a social precident similar in history and any personal effort on our part is well spent to preserve it.

I am sure you do not want me standing up representing your personal interest in amateur radio, for these aren't your likes and desires.

This is precisely my point.

IoAR is composed of individual members and there is no reason each cannot actively but even several thousand individual cries in promote and lobby for his particular specialty, the wilderness have no effect without some form of co-ordination. Whether by design or fate, each of the temporary directors in IoAR is fairly specialized in sphere of influence and personal interest.

I propose that IoAR become the most vocal stridently-insistant lobby in the amateur world. Guided by direction and suggestion of the directors, each in his own special interests, thru our own channels and the pages for IoAR in 73 each month, each member should direct one personal message per month to his ARRL Director, a personal message to the home address of John Huntoon or other salaried employee of the League, and one to the most appropriate Washington address indicated by current information. Not by mail, after all we have a fantastic communication system in amateur radio. Can you imagine the result in these comic strip nets on 80 CW when 10,000 30 to 50 group messages hit the NCS. After they give up, we will handle them on IoAR relay. For the first time, RTTY and plenty of it is a necessity. Here is an opportunity for a traffic organization that people will wait in line to join. If you think the Military won't suddently be interested in this type of operation, think again. The possibilities and complexities could only be handled by amateur radio. Each individual IoAR member can represent himself, or abstain from any issue. Each Director represents special amateur interests, not geography or mass, acting as a focal point and director of attention.

For some reason I have an idea that thought of mail or phone calls around Hdqtrs isn't going to be popular discussion, for the next few years. Just to keep those lovely secretaries busy, every member should write and ask one detailed technical question in regard to any current QST tinker-toy project every month. I have never known a group that talks as much and says so little as the US Amateurs, but if each reserved just 150 well chosen words a month and directed them in certain directions, mountains wouldn't move they would run.

1964 Special Surplus Catalog Section

Our special surplus issue last year brought so many compliments that we thought we'd bring it up to date. We've been using the catalog section quite a bit here at 73, but then I'm a surplus nut, as anyone can verify that has seen our barn.

There was a time when I darned near swore off surplus. It was right after the war when the War Assets Administration was giving large lumps of surplus to schools that would accept them. Well, imagine my delight when an SCR-547 turned up in the vacant lot next to my school. As president of the radio club I could see where we had some fun ahead of us trying to convert that into something useful. We tried to get some official action from the school on the thing, but couldn't find anyone to accept the responsibility. We got more and more frantic about it as the local kids played war with it, using the tubes for grenades and smashing everything breakable. Finally, in desperation, four of us rescued the remains for the club. This brought officialdom to life. The school decided that everything would be alright if we paid for the parts destroyed by the local kids. It was a bitter pill for us, but we paid. Somehow I've never encouraged anyone to go to that school since then.

I've been buying surplus again so I guess the wound has healed. We're busy converting APX-6's, AXT's and ART's for 432 and RDP's for watching the UHF bands for activity. We've got a surplus TV camera chain and some wide band FM gear. We hope to have all of this working from 73 mountain this summer.

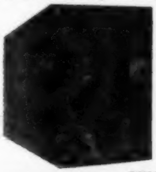
Surplus has done a lot for ham radio. Where would two meters have been if the SCR-522 hadn't been available in huge inexpensive quantities? Thousands of them were put on the air. I wonder if the original Gonset Communicator would have made it if there hadn't been all those 522's around? I'm still using a 522 as a driver for my high power rig on two meters . . . the final is a piece of surplus too (Herbach and Rademan $29.50). How many of you have *not* converted an SCR-274? Not many.

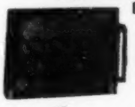
I buy surplus because I am a cheapskate and I want to get the most hamming with the least dollar investment. The following pages represent a pretty fair catalog of the surplus that is available today in all parts of the country. It is a lot easier to read it here than to try to visit Boston, New York, Ohio, Chicago and Los Angeles . . . and most of these fellows don't have time to put out a catalog.

SPECIALLY SELECTED "GOODIES", the CREAM of MILITARY and INDUSTRIAL SURPLUS at SKIM MILK PRICES.

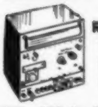
All items guaranteed as described, new except (*) removed from equipment, usually new, in good operable condition. Prices are NET, FOB our store, Chicago. Mail orders, please include enough for postage & insurance, excess returned with order. Illinois orders, add 4%.

IP-274/ALA-10, PANARAMIC ADAPTER, for 2 meter. 30 MC in, 10 MC width; 110v 400 cycle power supply. Quick, easy conversion, to 60 cycle, solid states power supply; also conversion to 14 MC input, if desired. With conversion schematic and instructions. Ex. used, complete with 3BP-1 and 17 other tubes. 7¾" w, 5" h, 19" d. Shipping weight 25 pounds. **$40.00**



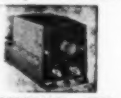


RT18/ARC-1, 100 to 156 MC Transceiver
10 channel, crystal controlled, with separate guard (monitoring channel). 9.1 MC IF. Complete with 2 832A, and all other tubes. 7½" h, 10½" w, 19½" d. Very excel. used, less 24v dynamotor with conversion instructions and schematic. **$25.00**



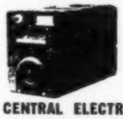
RT82/APX-6, 1296 MC Transponder (transceiver) Tunes the 1296 MC ham, or "moonbounce" band. Complete with all tubes. Very excellent used. **$17.00**

R11, 190 to 550 KC RECEIVER



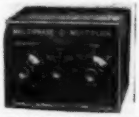
"Q-5er REBORN" With 85 KC IFs. See Sept. 1963 issue of 73, for conversion. Complete with all tubes, Ex. used $20.00; NEW **$30.00**

COMMAND SETS, back to 1947 prices!



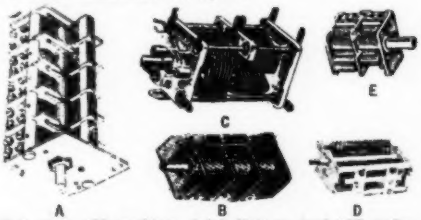
T-18/ARC5, 2.1-3 MC, for 160 meter. Ex used $5.25; BRAND NEW **$6.50**
T-20/ARC5, 4-5.3 MC, for 80, 6, or SSB VFO. excel. used clean **$5.00**
BC-458, 5.3-7 MC, for 40 meter, or CENTRAL ELEC. SSB. like new **$6.50**

CENTRAL ELECTRONICS' "Q" MULTIPLIER



The important parts for this unit—380 mmf & du-30 and 60 mmf variable; 455 KC IF; 20k pot; "Q" coil, wiring diagram & schematic. NEW **$5.00**
W/cabinet, no panel **$5.75**

VARIABLE CAPACITORS-PI NET, APC



A) 5 gang, 402 mmf/sec. total 2010 to load 160 meter, no inducance. ⅜" shaft. 60:1 worm drive.* good **$2.50**
A) AS above, less drive **$2.00**
B) 3 gang, 440 mmf/sec. ⅜" shaft **$2.50**
C) dual 150 mmf/sec. 1 KV, ¼" shaft **$2.50**
D) dual 250 mmf/sec 1 KV, ¼" shaft **$2.50**
E) dual 140 & 365 mmf, for BC rec. **39c**
G) 143 mmf, 600v APC. ¼" shaft. **69c: 3/1.95**

Vacuum capacitor. 50 mmfd 5 KV. * clean, good. **$2.00: 3/$5.50**

CO-AX CONNECTORS, LOWEST PRICES

A) CH-259, chassis male, for SWR bridges, T-R relays, VFOs, etc. **95c ea; 5/$4.50**
B) DOUBLE MALE, **DO NOT BIND,** **89c; 5/$4.25**
C) S-239, one hole chassis female **50c ea**
D) PL-259, E) SO-239, F) UG-21/U, choice **35c each**; 12 for **$3.75**; 100 for **$30.00**
E) UG-175, or UG-176/U, **11c; 10/$1.00**
G) PL-258, double female, **65c ea; 5/$3.00**

CO-ax CABLE

RG8/U, poly-foam, non-contaminable cover. BRAND NEW 50 feet **$6.50**; 100 feet **$12.00**
RG58A/U poly-foam, stranded center conductor, low loss; 50 ft **$2.50**; 100 ft **$4.75**

NUVISTORS-NEW, RCA, Bulk Packed

7587, tetrode, 5 watts on 2 meter, **$4.50 ea**
6CW4, sharp cut-off triode, **$1.85; 3/$5.25**
SOCKETS, for above, **15c ea**; w/3 above, **3/35c**

1625 TUBES-OUR VERY BEST BARGAIN

NEW, bulk packed KEN-RAD, **19c each.** Min mail order 12/$2.00; 50 for **$7.50**

CATHODE RAY TUBES—Mu Metal Shields

3EP1 **$1.95**; 3GP1 **$1.95**; 3AP1 **$2.95**; 3JP1 **$4.00**
5CP-1 **$5.50**; 5LP-1A **$7.50**; 5RP-1A **$10.00**

Mu Metal Shields for
5BP-1 **$2.50**; 5CP-1 **$2.50**; 3BP-1 or 3JP-1* clean **$1.75**

TUBES—TRANSMIT, RECEIVE, SPECIAL PURPOSE

3B28* **$3.25**; 6DQ5 **$1.75**; 815 **$2.50**; 5892 **$1.50**
$1.00 each, 4 for $3.75
807*; 6DQ6B; 1616; 3B24; 6J4*; 2D21; 6AN4*; 5687*
89c each; 3 for $2.50
6AS7G, or GA*; 6Y6G*; 5R4GY*; 6L6GA*; 6AG7*; 5T4
79c each; 3 for $2.25
VR-105; VR-150; OA2*; OB2*; 12AT7*; 12AX7*; 5651
69c each, 3 for $1.95
6AC7; 6SG7GT; 12SG7; 12K8; 12A6; 6SN7GT*; 6SL7GT
6AG5*; 6AK5*; 6AL5*; 6AQ5*; 6AU6*; 12AU7*; 12SF7
49c each, 3 for $1.35
5Y3GT*; 6X5GT*; 6K7; 12C8*; 12SR7*; 6C4*; 12J5*
29c each, 4 for $1.10
6SH7*; 955; 957; 1626; 6H6*; 76; 7193; 14B7; 7E7

HEAT DISSIPATING TUBE SHIELDS

See page 24 to 27, Feb. 1964 Issue of 73. For miniature tubes. Made by CINCH.
1½" high, for 7 pin 2" high, for 7 pin

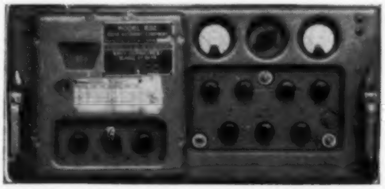
EIMAC HR-8

Heat dissipating plate caps, .578", for 811, 813, 866, etc. NEW **$.79 each 4 for $3.00**

9 Pin tube Straighteners. BRAND NEW, by STAR. All metal. **35c each, 3 for $1.00**

I'll be at: Starved Rock, June 7, (Ottawa, Ill.); Lancaster, Ohio, June 21.

BC Electronics 2333 S. Michigan Ave., Chicago 16, Ill., CAlumet 5-2235



RDZ RECEIVER, 10 channel crystal controlled, 200-400 mc, 115 volt 60 cycle power supply. Navy surplus and made to highest standards. Cost $2,500.00 each. We offer brand new units, original boxed, with antenna, plugs, schematic and crystal figuring data. Shipping wgt. 235 lbs.

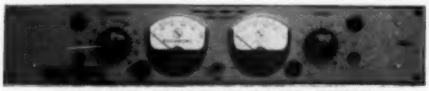
$125.00

SNIPERSCOPE, M-3, late model, permits viewing in total darkness. Ready to use, includes 20,000 volt power supply. You furnish 6 volts DC to operate. Used, checked out. Rifle shown in picture not included.

$225.00

PRS-3 METAL LOCATOR. Recent release, brand new in mfgr boxes. We include fresh batteries, instruc. book, spare tubes, and we open and check each unit for operation prior to shipping. When you receive the PRS-3, it is ready to operate and ready to find gold, beer cans, metal of all kinds, gum wrappers, etc.

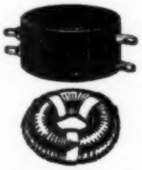
$45.00



REGULATED TRANSISTOR POWER SUPPLY

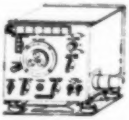
Model 212 by Electronic Measurements. Output 100 volt at 100 ma, variable. Standard rack panel mount, metered output. Used, checked OK.

$35.00



88 MH TOROIDS. Two types available. Open and potted. Used for many applications such as power supplies and teletype.

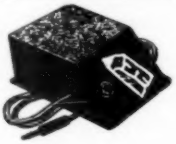
Open style	**50c** each
Potted style	**65c** each



LM FREQ. METER. Just bot another batch. Condition xlnt. with original calib. book and xtl, power plug, schematic.

$55.00

We have a few original Navy power supply transformers, so that you can make up an AC power supply. Xfmr only. **$2.00**



FL-5 NAVY BEAM FILTER, used as 1,000 cycle filter. Wonderful for CW use. These are brand new, boxed, with cord & PL-55 phone plug.

$3.00

MODULATION TRANSFORMER, brand new, good for 50 watts with 807's. Convenient size, made for Collins Radio for Navy use. 6000 ohms to 6000 ohms. . . . . **$2.25 ea.**

TELETYPE TAPE **$5.00 CASE**

For perforating, 11/16 wide. Oiled, case of 40 rolls only **$5.00.** Case weighs 50 lbs. Buy two and save on shipping.

GE PYRANOL CAPACITORS

.25 mfd	5,000 Volts	**$2.00**
10 mfd	600 Volts	**1.00**
1 mfd	3,000 Volts	**1.25**

POLYFOAM COAX CABLE . . . FRESH

RG-8/U	9c ft.
RG-58/U	4c ft.
RG-59/U	4c ft.

350 WATT DUMMY LOAD

We send you 7 non-inductive resistors each 344 ohms. Connect them parallel for 50 ohm load good for 350 watts. Bag of 7 resistors **$1.25**

ALL MATERIAL FOB LYNN, MASS.

JOHN MESHNA, Jr.

Surplus Electronic Material

19 ALLERTON ST. LY 5-2275 LYNN, MASS.

UHF SERIES
M-359
UG-175/U
SO-239
PL-258
PL-259
SO-239SH
UG260/U
UG-604/U

M-359	25c
UG-175	15c
UG-176	15c
SO-239	35c
PL-259	35c
PL-259D	90c
SO-239SH	40c
UG-260	35c
UG-604	35c
PL-258	75c

MAT HI FREQ TRANSISTORS

Micro-Alloy Transistors.
Hi frequency.
5 for $1.00

UHF TV TUNER **$4.50**

Complete with tube, used to convert Dumont TV for UHF channels. Seem to be useful with other types TV or use as converter. All unused.

BC-221-AH UNUSED	**$ 80.00**
BC-221-AK UNUSED	**100.00**

IBM WIRED MEMORY FRAMES.

Removed from high priced computors. Exlnt condition.

4,000 core	**$12.50**
8,000 core	**15.00**
16,384 core	**35.00**

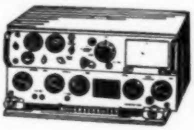
MEMORY DRUM w/drive motor, 40 read-write heads **$75.00**

SPECIAL ★ SPECIAL ★ 2 AMP SILICON RECTIFIER, 1,000 PIV **$1.00 SPECIAL**

UNBELIEVABLE COMPUTOR GRADE CAPACITOR

80,000 mfd 12 volt	**$4.00**
35,000 mfd 12 volt	**3.50**

AN/ART-13 100-WATT XMTR
11 CHANNELS
200-1500 Kc
2 to 18.1 Mc



Collins Autotune Transmitter, extremely stable and suited for side band. Written up in QST Oct. issue 1963. Used, with tubes. $50.00

We have parts, what do you need?

LAMBDA POWER SUPPLIES

Used, good shape.

Model #28	**$30.00**
#32	**50.00**
#32M	**50.00**
#C-280	**60.00**
#C-280M	**70.00**
#C-281M	**60.00**

NAVY RBA LOW FREQUENCY RECEIVER

RCA mfg, tunes in four bands from 15-600 kc. Direct reading dial, used by the Navy up to recent date and just being released. Outboard 115 AC 60 cycle power supply with each. Just the thing for you old shipboard sparkies. Also picks up the new long wave Navy stations on 60 kc. **$95.00**

2N389 NPN SILICON POWER TRANSISTOR

TO-53 case, 85 WATT 60 volt Silicon
$1.00 each

SILICON MESA TRANSISTORS

2 for $1.00

2N696	NPN	2 Watt	80 MC	TO-5
2N697	NPN	2 Watt	100 MC	TO-5
2N711	PNP	150 MW	150 MC	TO-18
2N705	PNP	300 MW	300 MC	TO-18
2N784	NPN	1 Watt	200 MC	TO-18

SILICON CONTROL RECTIFIERS

PIV	2 amp	20 amp
50	1.00	2.50
100	1.60	3.00
200	2.00	3.45
300	2.50	3.75
400	3.00	4.35

28 VOLT DC 40 AMP POWER SUPPLY

In put of 115 or 220 volts AC 60 cycle. A husky power supply useable in a multitude of ways. A suitable variac will permit variable voltage from 0-32 volts DC out. Shipping wgt. 150 lbs.
$50.00

MESA TRANSISTOR 500 mc
TO-18 case, sub min.
Germanium PNP, Vce 8 volt,
Ic 50 mil, 150 mw power
#TRANS-5 80 ea.
3/$2.00

ALL MATERIAL FOB LYNN, MASS.

JOHN MESHNA, Jr.

Surplus Electronic Material

19 ALLERTON ST. LY 5-2275 LYNN, MASS.

NAVY BEAM FILTERS

1020 cycles, same as FL-8 but more elaborate, with cord and PL-55 plug. Switching control on slant panel for easy viewing. New .... $1.95 ea.

Patch Cord Kit

Consisting of 2 ea. 24 inch cords, 2 ea. 14 inch cords and 2 ea. 6 inch cords. These come complete with plugs that fit standard meters and test equipment. Used for quick connect, all for 97c

TCS REMOTE SPEAKER

5" high quality, Jensen PM speaker. A built in transformer is a match for any low impedance headset output jack on any receiver. .... $4.95 ea.

GEIGER COUNTER

Uses famous Geiger Mueller Tubes, which detects gamma radiation. Comes complete with earphone and battery. New only .... $4.95 ea.

WIRE RECORDER

Compact wire recorder. Used for recording conversation in flight. Can be used in autos or boats since it operates on battery power. .... $7.94 ea.

SELSYN MOTORS

such as 5G, 5F, etc. 110 volt 60 cycle $4.95 per pair

60 MM MOVIE CAMERA

Magazine load type, complete with F3.5 lens. Battery operated. In excellent condition. .... $14.95 ea.

CHOPPER

6 volt 400 cycle. Uses: DC amplifier, tone generator or interrupter, etc. .... $.97 ea.

KEYER

Designed to provide automatic identification and to send automatic signal. Can be ued to key tranmitters, etc. $3.95 ea.

REMOTE AZIMUTH INDICATOR ASSYM.

Consisting of I-81 indicator, with built in autosyn and a model 2J1f1 selsyn generator with 60 cycle transformer all for .... $4.95 ea.

RDZ CRYSTAL OVEN

Will hold 10 crystals and works on 12 Volts AC or DC 95c ea.

TEST EQUIPMENT

TS-13 A/P signal generator, with self contained wave meter and power monitor. Frequency range from 9300 to 10,000 MC. .... $75.00 ea.

ART 22 noise and gate generator. Random noise generated by a magnetized 6D4 gas tube, is amplified and the output may be gated at a rate determined by external trigger source. .... $22.50 ea.

TS-239 U/P Oscilloscope. 110 Volts operations. 10 cycle to 5 MC duration of impulse. This equipment consists of a calibrating voltage generator, a timing marker generator and a trigger generator. In good condition $89.50 ea.

TS-102 AP range calibrator. Produces a square topped. 50 volt synchronizing pulse. .... $7.95 ea.

WHEATSTONE BRIDGE

Simply modified into a self contained wheatstone bridge by merely changing a few connections, and will accurately measure the value of unknown resistors, chokes and capacitors. New .... $7.95 ea.
Used 4.95

UPM 8 Signal Generator

Features, range 980 MC to 1230 MC. Can be used as signal geenator, pulse generator, power meter and receiver .... $49.50 ea.

TRANSMITTERS AND RECEIVERS

ARC-4 transceiver, 4 channel crystal controlled. Makes an excellent 2 meter mobile.	$29.50 ea.
12 VOLT DYNAMOTOR for above	$14.95 ea.

ARC-5 Receivers

3-6 MC automatic selector type	$7.95 ea.
6-9 MC	6.95

ARC-5 Transmitters

2-3 MC	$4.95
3-4 MC	6.95
4-5.3 MC	4.95
5.3-7 MC	4.95
BC 456 Modulator for command transmitter	3.95
ARC-5 VHF transmitter 100-156 MC	14.95
APX-6	14.95
50 CHANNEL ARC-1 transceiver 100-156 MC for 2 meters or even 6 meters	49.50

MOBILE POWER SUPPLY

12 volt transceiver power supply consists of dual dynamotors. Mounted on filtered base with starting solenoid 420 volts at 200 MA and 200 volts at 100 MA. Can be used for ARC-5, ARC-3, 522, etc.

SPECIAL

RA-62 POWER SUPPLY, 110 volt AC rectifier Power Supply for 522, ARC 3, ARC-4, ARC-5, etc. $39.95

PE-98

12 volt SCR 522 dynamotor. New .... $6.95 ea.

MOBILE WONDER

12 volts in, 24 volts out at 4 amps. For operating 24 volt equipment on your 12 volt car battery. 10x4x6 inches, water and moisture proof. .... $9.95 ea.

TELETYPE

88 MH mounted in a protective casing in new condition. 5 for $1.25

Teletype Power Supply

150 volts AC input, output 120 volt/75 at 35 watts $4.95 ea.

Teletype Power Supply

115 volts input, output 120 volts/130 at 130 watts $9.95

Teletype Power Supply

110 volt input, output 120/130 volts at 200 watts $14.95

for Model #15 Teletype Base

In new condition, less hardware .... $4.95 ea.

Teletype Keyboard

Brand new	$19.95 ea.
TD COVER	$2.49 ea.

MISC. TUBES

6114 ruggedized 12AU7	5 for $1.00
1625	4 for 1.00
1P28 Photo Multiplier	4.95 ea.
931 A Photo Multiplier	2.95 ea.
Sub miniature assortment removed from late equip.	6 for 1.00
3EP1 scope tube	.97 ea
3DP1 scope tube	2 for 1.00
2C46 lighthouse	1.75 ea.
2C42 lighthouse	1.49 ea.

Germanium Rectifier

Mounted in heat sink plate, 200 volts 5 amp per plate, 4 plates in stack can be assembled to higher current lower voltage .... $1.49 per plate

2 VOLT STORAGE BATTERY

Rechargeable type, 20 amp hour $2.49

6 Volt DYNAMOTOR ASSYM.

Mounted on a 19" panel, completely filtered, output 225V at 60 MA. New $2.96

HOFFMAN SPECIAL

Hoffman TV remote control, consisting of 8 push button channel selector, motor drive and remote speaker, 25' of cable, new $6.95

Hoffman Stereo Remote Balance

For remote control balancing of 2 speakers complete with 25' of 3 wire cable. New $1.95

MODULATION TRANSFORMER

Collins 20W, 200 to 5000 primary Z 6000 secondary Z 6000 .... 97c ea.
2 for $1.75

NAVY WEATHERPROOF OUTDOOR SPEAKER

12" diameter, heavy duty housing was used on shipboard for speaking to navy personnel, mfg. by Jensen. Brand new $17.50 ea.

CRADLE TELEPHONES

WITH DIAL $3.95
Without Dial 2.95

WALKIE TALKIE SPARE PARTS KIT

Consists of 24 crystals, 5 antenna coils and 5 tank coils, all in wooden carrying case .... $3.95 per kit

VHF FIELD STRENGTH METER

With 200 microamp meter and collapsable antenna, vernier dial tunes from 90 to 160 MC $9.95

SOUND POWERED TELEPHONE HANDSETS

consists of 2 sound powered handsets, 200 feet of wire, light compact and new all for $14.95 per pair

24 VOLT GENERATOR

10" long by 6" in diameter. Produces 28V DC at 25 amps .... $7.95 ea.

VARIACS

3 Amp variac 125 volts 60 cycles, in good condition $6.95 ea.
115 volts primary, 240 volts 10 amps secondary $29.50
115 volts primary, 0-135 volts secondary at 15 amps $29.50
110 volts, 10 amps, 400 cycle $3.95

ONE OF KIND

TS-147D Test set. X band signal generator, like new cond. .... $350.00 ea.
TS-323/UR Frequency meter 20 to 450 MC $195.00 ea.

OS/8 pocket scope 3" portable $97.50
TS 186/UP Frequency meter. 100 to 10,000 MC $195.00 ea.

TS 175/U Frequency meter 85 to 1000 MC $149.50

TS 174/U frequency meter 20 to 250 MC $149.50

USM-32 precision compact scope 6"x8"x14" $149.50

TS-148/UP Spectrum Analyzer $195.00

GONSET COMUNICATOR 111. With crystals Excellent condition $135.00

ARMY SNOOPERSCOPES in carrying case good conditon $35.0

AN/USM-24 Oscilloscope $225.00

SPECIAL

ARC/T11 VHF Transmitter, covers 116 to 132 MC. Can be used on 2 meters with slight modification. 2 watt output. 4½" x 6" x 4½". Weighs 3½ lbs. With tube $19.95

SPECIAL

Sextants Late style, features automatic averaging readings. All you do is sight it. Automatic features gives you average reading of about 60 sights in 2 min. with carrying case $8.95

Telephone Dial

Standard Phone dials ideal for use in any remote control relay circuits. $1.25

Antenna Relay

BC-442 consists of switching relay, 0-10 RF indicator & 50 MMF vacuum capacitor new $2.25

CRYSTALS

100 KC mounted in metal sealed holder ½" spacing. New not surplus .... $4.95 ea.
1000 KC metal sealed holder ½" space 4.95
10,000 KC metal sealed holder ½" space 2.95
200 KC metal sealed holder ½" space 1.95
Ceramic crystal sockets for ½" spacing 25c
for above crystals

J. J. GLASS ELECTRONICS

Terms:
FOB our warehouse, L.A. Cal. 25% deposit with COD order, Calif. buyers add 4% tax. Minimum order $5.00.

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CALIFORNIA
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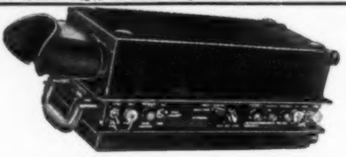
GENERAL RADIO #1217A UNIT PULSER with #1203A pwr sply. Rise time .05 usec, fall .15 usec. 0.2 to 60,000 usec duration, calibrated. Top flat to 5%, overshoot 1/than 2½% of max. amplitude.	99.50



$850 TEST OSCILLOSCOPE FOR ONLY $39.50

TEST SCOPE TS-34( )/AP: Ready to use! Internal hard-tube sweeps 10-50,000/sec., plus triggered sweeps for pulses. Video 11 cy to 3½ mc. Magnif. lens simulates appearance of a 5" picture. W/reprint of 17 Handbook pages. Checked OK.

DuMONT #304A most-popular DC-150 kc Test Scope. 5" flat-face CR tube. Vert. Defl. calibrated. W/book	149.50
DuMONT #264B Calibrator for vert. defl., any scope	14.95
DuMONT #401A & 401AR (Rack Mt) is "the most advanced low-freq. scope ever made." DC-150 kc. Sensit. 10 mv/cm. Hard-tube sweep. Identical X, Y amplifiers	199.50
DuMONT #321 Scope Camera, still or variable-speed 16 mm. W/fl. 5 lens, stand, 4 magazines, book, regular $1395	395.00
TEKTRONIX #511A Test Scope 10 cy-10 mc video pass. Sweep calibr. in usec/cm. W/brand-new 5ABP1 flat-face tube installed, sens. 130 mv/cm. W/book	230.00
TEKTRONIX #511AD is same plus Video Delay Line	275.00
RCA WO-79A is 3" scope with meter in front panel for use at VTVM	79.50
RCA WO-56A TEST SCOPE has 7" CR TUBE! DC to 500 kc, sweeps 3-30,000. With book	79.50
SPENCER-KENNEDY LABS #202 Wide-Band Chain Amplifier, fixed gain 20 db. 1 kc to 210 mc; rise time .0026 usec. Zi & Zo both 200 ohms. Vo max. 4 v rms. W/regulated power supply	125.00
POWER SUPPLY FOR ART-13 and other similar Transmitters. You make the 24 v dc 10 amps you need with your xfrmr & silicon rectifiers; plenty of room in the cabinet. This unit furnishes both HV's you need filtered. 1300 V at .35 A and 500 V at .425 A. Metered, in handsome cabinet 37" h, 21" wd, 15" dp., net wt 229 lbs, shpg wt 350 lbs. NEW! Gen. Elect., cost Navy $1000.00! FOB Tacoma, Wn. with data, no plugs	79.50
HANDY-DANDY ROTARY INVERTER puts out 115 v 3 ph 400 cy 250 VA. Input 28 v dc 22A. W/Mating plug, checked	9.95
NAVY EAO POWER SUPPLY FOR TBX RECEIVER brand new with spares, easily modified to standard receiver-type (unregulated) supply	9.95
MALLORY POWER SUPPLY NA-1500: Vi 230 v 3 ph 60 cy. Vo DC 12 v 100 A or 24 V 50 A. FOB Mobile, Ala.	79.50
MAG-AMP REGULATED DC POWER SUPPLY. Perkins #28-30 WXM. Vi 95-130 v 1 ph 60 cy, Vo adjustable 24-32 V, 0-30 Amps. Max. ripple 1%. Static & Dynamic regulation ½%. 2 large 2% meters. Perkins price $723.00. From us fob Los Angeles only	195.00
SORENSEN #Q-28-0.5 Regulated DC Power Supply in cabinet, unmetered, all solid state. Vi 105-125 v. Output adjustable 18-36 v dc, 0-500 ma. holds to ¼% for combined line & load changes. Regular $200.00. From us FOB Los Angeles only	39.50
SORENSEN B-NOBATRON #300B RANGER in cabinet w/2, meters for E & I. 0-300 VDC, 0-150 ma. Reg. 0.15% max. ripple 5 mv. Also two 6.3 vac 5A outputs. Regular $310.00 but from us only	69.50
DRESSEN-BARNES #3-150B in rack cabinet w/meter, 0-300 V dc regulated 0.15% line & load, 0-150 ma. plus negative 150 v dc bias, plus 6.3 v ac CT 6A	69.50
DRESSEN- BARNES #3-1.5MB: Regul. Pwr sply, rack mtg, w/2 large meters for E & I. 0-300 vdc at 0-1500 ma plus 0 to -150 vdc plus 6.3vac ct, 10 amps	129.50
DRESSEN-BARNES D3-300E. Regulated DC outputs 0-300 v at 0-150 ma plus 0-300 v at 0-300 ma plus 0 to −145 v at 5 ma plus unregulated Powerstat-controlled and metered 10 v ac up to 10 A. Small meter for AC, two large meters for DC E & I	99.50
ELECTRONICS MEAS. CORP. #200B: Reg. DC supply in cabinet w/2 large meters, 0-300 vdc, 0-125 ma, 1% regul. line & load, 5 mv max. ripple	69.50
ERA #TR300-1 ALL SOLID-STATE regulated DC supply in cabinet w/2 meters, adjustable Vo 165-300 vdc at 0-1000 ma. Line regul. .05% 105-125 v, load reg. 0.1% Regular $595.00	129.50
UNIV. ELECTRONICS TWIN Regulated Supply. Switch puts two 0-400 V DC in series, in parallel, or either or both separately. Approx. 65 W from each output, self protecting. If load increases to max. on meters of 250 ma, tops at 250 v, won't rise above. At 100 ma, each supply tops at 410 v. 2 large meters. Also 2 separate 6.3 v ac 8 A	129.50

POWER DESIGNS INC. #304M2 rack mtg regul. pwr sply 250-300 vdc, 0-500 ma plus two 6.3 vac 5A. Two Weston #741 1% meters for E & I	69.50
HEWLETT-PACKARD "High Stability" #710B in cabinet, unmetered, adjustable Vo 100-360 v dc, 0-100 ma, also 6.3 vac 5A	37.50
HEWLETT-PACKARD #715A Klystron Power Supply, Details on request	99.50
HEWLETT-PACKARD #717A Klystron Power Supply, Details on request	129.50
IMPEDANCE BRIDGE ZM-30/U (AN/URM-90) similar to ESI's #250DA ($495). 3-unit concentric dial. Galvo for dc null, magic eye for ac null, int. osc. 1 kc. ext. to 10 kc. .0001 ohm to 11 meg ±.15%; 0.1 uuf to 1100 uf ±.5%; 0.1 uh to 1100 H ±1%. Q. .02-1000; D. .001 to 1.05; both ±5%. W/Handbook	250.00
HEWLETT-PACKARD #803A VHF BRIDGE	295.00
SHALLCROSS #617B %-LIMIT BRIDGE OHC by Shallcross	188.00
L&N #5365 Power Cable Fault Bridge plus 6 amp Rheostat	275.00
SIGNAL CORP I-49 (ZM-4( )/U) Wheatstone Bridge approx. 0.1% accur., 0-10K X.001 to X100 w/Instructions	125.00
Gen. Radio **#783A AF POWER METER,** regular $410	175.00
WESTINGHOUSE PX-5 PRECISION DC VOLTMETER ½% FS 0-750 v	99.50
L&N Students Pot. #7651 w/book, 0-1.5 v, steps of ½ mv, ±.04%	59.50
L&N Kelvin-Varley Voltage Divider 0-350v, dc to 400 cy, use same as potent., ±.01%, reads 4 digits. W/instruct. to measure E & I	69.50
METER TEST SET TS-682/GSM-1, you fix one meter	395.00
Biddle-Evershed Bridge Megger 0-1000 megohms	150.00
RCA #69-C (MI-7512-H) Noise & Distortion Meter	99.50
Gen. Radio **#1303-A** Two-Signal Audio Generator for use as osc. 20-40,000 cy or measure IM by SMPTE or by CCIF methods or measure Harmonics. With Gen. Radio #736A Wave Analyzer (4 cy width) for use as Detector 20-16,000 cy. Total catalog value $2,825. In grtd-OK condition both for	595.00

STABILINE IE-20060: 3kva Line Volt, Regul. Adjust Vo 110-120 v 1 ph 50/60 cy. holds ±0.1% for line changes 95-130 v and/or load changes 0-26 A. Electronic, almost instant correct., no mvg parts, max. harm. 5%. On 19" rack panel 21"h, 14½" dp, no cabinet. Mil Spec HS xfrms & chokes. Regular $960, but from us, brand new, w/dwgs. & data 330# fob Utica, N. Y. only (If cabinet needed, add $30.00.)	279.50
STABILINE S429 is Mil EM4106 6 kva electromech. line regul. 95-130 v 1 ph 45-65 cy. ZERO harmon. 0-52 A. Metered in cabinet, exc. used. OK grtd, fob Utica, N. Y.	279.50
STABILINE EM type S345 2 kva made special for Litton Ind. as CN-203/MRN, same ckt. in slide-out drawer, brand new fob Utica, N. Y. W/dwg.	149.50
SORENSEN 3000SH is Mil-Spec HS xfrmr/choke electronic regulator, 95-125 v in to 110-120 Vo ±0.1%. Max harm. 3%. In cabinet, factory overhauled & grtd, w/book, fob So. Norwalk, Conn.	279.50
SORENSEN #1500 SPECIAL Line Voltage Regulator, all electronic, V' 105-125 v 60 cy, Vo adjustable 110-120 v. holds to 0.3% for rated line input variations and for load variations 150-1500 VA. Max. harmonics 5%. FOB Los Ang. (factory overhauled) w/book	179.50
SORENSEN #10,000S: Same specs as the #3000SH except 0-10 kva. Factory overhauled & grtd, w/book; fob So. Norwalk, Conn.	595.00
Sorensen #500S: Same specs as above except 0-½ kva. Checked, grtd, fob Los Angeles	99.50
SOLAVOLT #5106: Harmonic-corrected Sola Constant-Voltage Transformer 500 W in case w/contin.-adjust. autotransformer for regul. 0-135 v ±1%. Unmetered model	49.50
SOLA 190-25' Vi to 230 Vo ±1% fob Los Ang.	89.50
G.E. Isolatin STEP-DOWN/STEP-UP xfrmr 120/240 v 1 ph 50/60 cy 7½ kva fob Oakland	49.50

PLENTY MORE: For example, on way in to us now is Hewlett-Packard 0-10 mc digital counter; not mentioned here is our large stock of Brush graphic recorders, Varian mv recorder, transistor tester, tube testers, tuning fork oscillators, VTVM's etc. Always BUYING! SO IF YOU HAVE SOMETHING TO SELL US, tell us about it and PUT A PRICE ON IT same as we did in this ad . . . we didn't ask YOU for offers! AND WRITE US ON YOUR SPECIFIC NEEDS!

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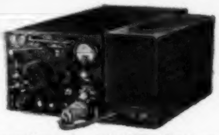
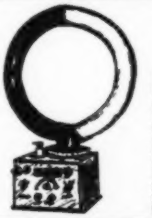


ALL-BAND SSB RECEIVER BARGAIN: R-45/ARR-7 has 2 stages RF, 2 stages 455 kc IF, separate Local Osc. w/VR AF, S-Meter, Noise-Limiter, Crystal & non-crystal IF Pass in 6 pass selections . . . and now we add PRODUCT DETECTOR in the empty socket left by removal of the reradiation supressor preceding the 1st RF. Goes on when BFO is flipped on, works like a charm! CONTINUOUS TUNING 550 KC to 43 MC! Voice, CW, MCW. With 120/230 v. 50/60 cy power supply, ready to plug in and use. HOT and SHARP! With book 90 lbs fob LA	**199.50**
Same but without the SBB addition fob San Antonio	179.50
TIME PAY PLAN: Any purchase totalling $160.00 or more send us only 10% for Down Payment!	
NEW LOW PRICES ON TELETYPE! Model 14 Transmitter-Distributor, with cover, synm motor, only	**37.50**
Mod. 15 w/keyboard, plus Mod. 14 Typing Reperforator, plus Mod. 14 Transmitter-Distr., all in handy operating console cabinet fob Los Ang. only	**175.00**
Mod. 19 plus same additions in same Console	195.00
TM11-352 on Mod. 15, $5.00. TM 11-2222 on #14TD, $5.00. TM 11-2216 on Mod. 19, $8.00. TM 11-2223 on #14 Typing Reperforator, $8.00.	
NEW LOW PRICE on latest-type MINE DETECTOR: AN/PRS-3 has waterproof Search head, coils embedded in plastic, drag under water or use above ground, find PIRATE'S GOLD or PLUMBER'S PIPES! Exc. cond., with all parts & Handbook in Fiberglass Suitcase, 40 lbs, fob Tacoma, Wn., only	**19.95**
NEW LOW PRICE on ungraded SILICON DIODES, various PIV's & Currents, some good, some bad, you grade them with Instruction included. 100 for only	**2.95**
LOW FREQUENCY LONG WAVES RCVRS: Superhet DZ-2, 15-70 and 100-1750 kc. You make power supply same as in a Command Receiver (250 v & htr for 6 v tubes)	**79.50**
RCA Shipboard VLF Superhet, 70-1500 kc cont. Exc. cond. and works hot as a firecracker. Ready to go on 115 v 60 cy. No other information available. Only	**69.50**
R-44/ARR-5 AM/FM superhet 27-140 mc. reradiation suppressor removed & bypassed, 6AK5 substituted for acorn to make it HOT, and 5.25 mc IF brought out to pin jack on front panel case in double converting Look same as picture at top of page.	**179.50**
HALLICRAFTERS S-37 Receiver AM/FM w/6AK5 substitutions as above, 130-210 mc AM/FM	**179.50**
455 KC PANADAPTOR BC-1031-C like new, with book, fob Los Angeles only	**99.50**
RBS RECEIVER 14-TUBE superhet 2-20 mc, aligned, w/pwr suply, instructions, only	**69.50**
BC-348-P Rcvr, checked OK operating, no power supply. 1.5-18 mc. W/Schematic	**69.50**
RT-18/ARC-1, 100-156 mc Rcvr-Transmitter in shock-mt connection-making rack, 10-channel Autotune, w/schem. & setup instructions which show all power voltages, currents needed	**39.50**

Add DIRECTION FINDER To Your Receiver



Navy DU-1 gives TRUE BEARING in 3 seconds! No 180 deg. ambiguity! Goes ahead of your receiver; takes 200-250 v., 16 ma and heater voltage from your receiver. 2 12SKY7's in tuned preamp and phasing circuit, 200 to 1600 KC in 3 bands. Instructions tell how to modify to get Marine Band if desired. Only 7 lbs. net wt. 11" loop, 4½" azimuth scale. BRAND NEW, with plugs, mount, diagram, instructions **29.95**

NOISE & FIELD STRENGTH METER, STODDART NMA-5A with I.F. and plug-in Tuner for 88-400 mc. with book	**199.50**
FM XMTR-RCVR base station, Farnsworth AN/FRC-6A, puts 50 W into antenna, 30-40 mc, Voice. 120 v 60 cy pwr sply, speaker, meters, etc. in rack cabinet	**99.50**
AN/APR-4 RECEIVER SET w/Tuning Units TN-16 & 17, 38-300 mc, checked 100% OK, w/plug & Handbook	**149.50**
(Write for prices on AM/FM type and on other tuning units, up to 4 kmc.)	
R-111/APR-5 RCVR 1-3. kmc AM has 115 v 60 cy pwr sply built in, exc. for SPECTRUM ANALYSIS	**79.50**
A Model goes to 6 kmc	99.50
A Model in rack w/30 mc Panadapter RDP, also 115 v 60 cy, displays ±5 mc, plus other material, useful also for APR-4 Set above which also has 30 mc. I.F.	**199.50**

LM FREQUENCY METERS 125 kc-20 mc, with Cal. bk, plug, xtl, instruct., gorgeous	**57.50**
LM FREQUENCY METER same as above except with somewhat dog-eared calibration book, guaranteed 100% readable! Only	**42.50**
TS-175/U FREQUENCY METER 85-1000 mc, crystal calibrated, wit serial-matched Cal. Bk. & Handbook, exc. condition!	**150.00**
MAKE POWER SUPPLY for LM's and/or TS-175 by modifying brand new EAO 60 cy portable power supplies with Instructions and Silicon Diodes we supply. 47 lbs fob San Diego	**9.95**
GENERAL RADIO Type 620A FREQUENCY METER, 300 kc to 300 mc, .01%, crystal calibrated	**99.50**
TS-186(*)/UP FREQUENCY METER, 0.1%, crystal calibrated, 100 mc to 10,000 mc! With calibration book, crystal, waveguide-to-Coax Adapter, Handbook	**199.50**
TS-69/AP WAVEMETER 350-1000 mc, w/Calib. Charts, tune for max. reading on large Microameter	**69.50**
TS-311A/AP Echo Box COMBINED WITH Crystal Tester! 8730-8910 mc	**49.50**
TS-501/UP Echo Box 6250-3900 mc	49.50
TS-488/UP Echo Box w/Horn, 8990-9160 mc ±0.5 mc	**79.50**
GENERAL RADIO WIDE-BAND BEAT-FREQUENCY OSCILLATOR generates 50 cy to 5 mc in 2 accurately-calibrated bands, put 10 v into open ckt constant ±1½ db. Not Gen. Radio's $750.00 but only	**129.50**
BOONTON UNIVERTER 203B beats your VHF signal generator a 70 mc to provide 100 kc to 25 mc at same Vc as you set at the VHF generator, ± 1 db	**99.50**

NAVY VERSION OF GENERAL RADIO #605-B

LP Microvolter, 9½ kc —30 mc dial-calibrated ±1%, 7 bands & 30-50 mc graph-calibrated. CW or mod. 1000 cy, 0-50%, read on VTVM. Output calibrated ½ uV to 0.1 V at lower plug & 1.0 V at upper plug. Logging scale w/300 divisions & vernier knob w/135 divisions provide super-accurate resetability. Stability is phenomenal. Holds a zero beat with WWV for 12 hours with less than 100 cy drift. Aligned, guart'd, ready to use on 120 V. 60 cy, only **199.50**

TS-413/U SIGNAL GEN. 0.75-40 mc, 1%, xtl calib., Vo calib. to 1.0 v. Certif. w/book.	**279.50**
GEN. RADIO's SUPER-DE-LUXE LOW-FREQUENCY Standard Signal Generator #805-C. In the current Cat. R it is almost identical, called D Model, at $2250. In Cat. Q it is C Model, $1975. 16 kc-50 mc. Puts 2 v into 37½ ohms; ½ reading into 50 ohms with simple 2-resistor pad. W/book. 100% grtd.	**795.00**
BORG-WARNER (ROLLINS) Model 30-A 40.7-400 mc High-Pwr Standard Signal Generator AM, PM, CW, puts up to 10 volts into 50 ohms w/accurate attenuator; in High position (CW only) puts out 10 watts at most frequencies. With book. Current price is $18,000! EXCELLENT for RFI measurements, Antenna Pattern work, etc. 100% Grtd OK	**1295.00**
PRECISION APP. CO. Series E-200-C Serviceman's Signal Gen. 90 kc to 120 mc, apparently OK	**39.50**
NAVY LX-2 is Wash. Inst. of Tech. version of Gen. Radio Mod. 804B Standard Signal Generator, 7½ to 330 mc. 100% grtd, w/schematic.	**149.50**
MEASUREMENTS CORP. Mod. 80 Standard Signal Generator: 2 to 400 mc ±½%, Vo calib., .1 uV to .1 V. 100% grtd, w/book.	**375.00**
NAVY LAE-2 BRAND NEW with serialized charts, graphs, Handbook, puts out same uV as above but 520-1300 mc ±1%, CW & PM w/provisions for external sine mod. AM PM has variable pulse width and delay. With all cords	**129.50**
50% DISCOUNT on Gen. Radio Standard Signal Generator #1021A. ½ uv to 1 v into 50 ohms, ±2 db, also direct reading 0 to -126 dbm. AM 0-50%, 1 kc. Extremely low leakage. Cabinet w/Pwr Unit 1021P1 & Osc. 1021P3, 40-250 mc. 100% grtd OK. W/book	**397.50**
Same except w/Osc. 1021P2, 250-940 mc	397.50
Cabinet w/pl & P3 PLUS EXTRA plug-in osc. P2, covers 40-940 mc. ½ Cat. price is	**635.00**
C-BAND: POLARAD MSG-3 Signal Gen. 4.5-8 kmc, -10 to -125 dbm into 50 ohms. Similar to Hewlett-Packard's $2250 #618B	**695.00**
WRITE FOF PRICES on TS-419/U, 900-2100 mc, and on POLARAD MSG-34, 4-11 kmc.	
KAY MEGASWEEP #111A checked 100% OK only	175.00
X-BAND SPECTRUM ANALYZER TS-148/UP w/Handbook and flexible Waveguide attachment	**195.00**
Same in Shpg Case is **AN/UPM-33A**	245.00

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TELEMARINE FOR THE BEST IN SURPLUS!

WALKIE-TALKIE

MODEL "MAB" is a Navy Walkie-Talkie which provides single-channel, crystal-controlled reception and transmission (AM) between 2.0 and 4.5 MC. Receiver uses miniature tubes in a **superheterodyne circuit** for maximum sensitivity and selectivity. Transmitter employs miniature tubes in a crystal-controlled oscillator (1T4), a 3S4 RF Power Amplifier which will deliver from 200 to 250 milliwatts RF power to the antenna (can be souped up), and a 3S4 Heising (plate) Modulator stage. 7 tubes total in trans-receiver. Unit is housed in a water-tight bakelite case. 7½"H. x 10"W. x 3-9/16"D. RANGE 1 MILE OR BETTER, depending on location and conditions. Requires 135 volts "B" and 1½ volts "A" batteries. Excellent for 75 meter Ham. CD. Fire Dep't, emergency marine, or conversion to other uses. Supplied Complete with all tubes, r'c'ving & x'mitting crystals (sorry, we cannot accept orders for a specified frequency. Crystals are FT-243 type, and can be easily changed), telescopic antenna with adjustable loading coil, headphones, microphone, and canvas carrying case with straps. In Almost-New condition, but not-tested at this price. Shpg. wt. per set 15 lbs. **EACH** .... as described, only $12.95

PER PAIR .... 2 Complete Sets, as above $24.50

MODEL DAV is a Navy Walkie-Talkie, same as above, but with Direction Finding Loop within so that receiver section may be used for D.F. or Homing on the crystal-controlled receiving frequency. Same transmitter as outlined above for Walkie-Talkie use with supplied adjustable telescopic antenna. Encased in watertight, sturdy plywood case, slightly larger than above. Shpg. wt. Complete with accessories as for MAB. 20 lbs.

EACH, AS NEW—but not tested at this low price $16.95

INSTRUCTION BOOK FOR MAB OR DAV
only with purchase of units .... $ 1.00

MINIATURE VIBRATOR PACK FOR MAB OR DAV, eliminates nuisance and expense of dry batteries. Operates from miniature 6 volt storage battery, not supplied, available from many surplus dealers. With Instruction Book. Shpg. wt. 5 lbs. UNUSED. **EACH** $7.95

NEW, WALKY-TALKY (BC-611) CHASSIS

Here's the chance to build your own real compact, lightweight hand-held Walky-Talky! Designed to transmit and receive on one (crystal-controlled) freuency between 3.0 and 6.0 mc., any real Ham could revamp the coils for operation on higher frequency amateur phone bands. This will result in increased antenna power output and longer distance transmission. By building your own case for this chassis, with space for larger batteries and increased B voltage, further increased power and longer service from batteries will result. These chassis are NEW, unused, complete with telescoping antenna but less tubes, coils, or crystals. Tubes reuired: 1—1R5, 1—1S5, 1—1T4, and 2—3S4. 2 miniature plug-in coils required (sold separately), 1—Antenna, and 1—RF Tank. Battery voltages required (original) 1—1.5 volt "A" and 103.5 volts "B" battery, the latter may be increased to 135 or 167.5 volts to produce higher transmitter output. Supplied as specified with Schematic diagram. Shpg. wt. 6 lbs.

EACH—Chassis only **$8.95**

PAIR OF COILS, for above, Ant. & RF Tank $1.25

ACCESSORIES FOR ABOVE

CAST ALUMINUM HOUSING, case for Above Walky-Talky. Includes battery compartment. Push-to-Talk Switch with rubber weatherproof cover, top and bottom covers. All items separate for home assembly. **PRICE**, as outlined **$17.75**

ALUMINUM HOUSING ONLY. Less Top & Bottom Covers or push-to-talk switch $9.95

MICROPHONE OR RECEIVER ELEMENTS, with matching transformer and bakelite covering caps.

EITHER ELEMENT (New) $5.50

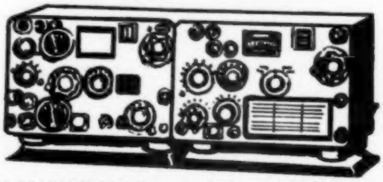
TEST UNIT I-135. Contains Microphone and Receiver elements. Volt-Milliammeter, and RF Pierce Oscillator circuit to thoroughly test above Walky-Talky. Parts can be used to help complete unit. Used-Excellent. Shpg. wt. 35 lbs.

PRICE. EACH $17.95

PUSH-TO-TALK SWITCH, and Fulcrum assembly for actuating trans-receive slide-switch on chassis. Also includes separate rubber cover for inclosing and weatherproofing switch. Shipped Postpaid (add 10c if insurance desired).

PER SET $1.95

SENSATIONAL BARGAIN!! TCS TRANSMITTERS, RECEIVERS, AND ACCESSORIES



TCS TRANSMITTER. Famous work -horse of the Navy, rugged, efficient reliable. Delivers 20 watts phone, 40 watts CW in 1500KC to 12.0 MC range. Incorporates VFO or 4-crystal controlled channels. Excellent for mobile or fixed station use. Complete with tubes, Used-Very Clean condition. Shpg. wt. 60 lbs. All Accessories extra.

EACH, not tested at this low price $39.95

TCS RECEIVER, companion to above 1.5 to 12.0 MC in 3-bands. Continuous tuning of 4 fixed crystal controlled frequencies selection. Employs a stage of RF amplification and 2 stages of IF to provide good sensitivity and selectivity. Requires separate Power Supply. Excellent for Hams, CD, MARS, etc. Shpg. wt. 50 lbs. USED—EXCELLENT Condition.

PRICE EACH, not tested at this low price, with tubes . $49.95

TCS 12 VOLT DC POWER SUPPLY, to operate above units from 12 V. DC. Contains 2 Dynamotors, one for transmitter and one for receiver supply, complete filtering, starting relay, etc. NEW UNITS. Shpg. wt. 40 lbs. **PRICE EACH** $17.95

TCS REMOTE CONTROL UNIT with built-in loudspeaker, volume control, microphone and phone jacks. Shpg. wt. 10 lbs.

NEW UNITS, EACH $9.95

As Above, but "Used—Very Good" $6.95

Plug Connecter for Remote Control $1.50

TCS CONNECTOR CABLE. Transmitter or Receiver to Power Supply. Shielded. (Specify which). 3 foot length $5.95; 11 foot length wt. 5 lbs. $9.95.

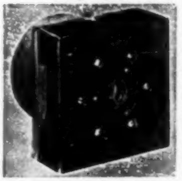
TCS ANTENNA LOADING COIL, permits use of short, whip type antennas on lower frequencies. Shpg. wt. 8 lbs. "Used—Good."

EACH $6.95

30-40 MC DE-LUXE FM RECEIVER. Model R-237/VRC—2 Single-Channel, Double-Conversion Superhet, with features such as double limiter, squelch circuit, crystal-control of both 1st and 2nd Converter Oscillators, built-in 6 V DC Power Supply, etc. Dimensions 11½" x 10" x 15". Used—Excellent condition units, with tubes, 2nd conv. crystal; no control unit or loudspeaker, with schematic diagrams. Shpg. wt. 65 lbs. **EACH** **$29.95**

TRANSMITTER COMPANION TO ABOVE. Model T-193/VRC—2. Power Output 25 watts, Crystal-controlled single-channel unit with built-in 6 V DC Power Supply. Can be used for NB FM amateur transmissions, or may be applicable to Fire, Police, or other applications. Used—Excellent conditions units. With schematic. Shipping weight 65 lbs. .... **EACH** **$19.95**

25-30 W. SPEAKER UNIT



Western Electric Speaker units, D173246, for horn or baffleboard mtg. Shock and blast proof diaphragm, will handle up to 30 watts. Response to 12,000 cps, favoring high freq. Impedance 5.5 ohms. Dim: 4 3/16" x 4 3/16" x 2 9/16" deep. Throat opening—1⅛" dia. Alnico 5 slug. wt. approx. 3 lbs. Shpg. wt. 8 lbs.

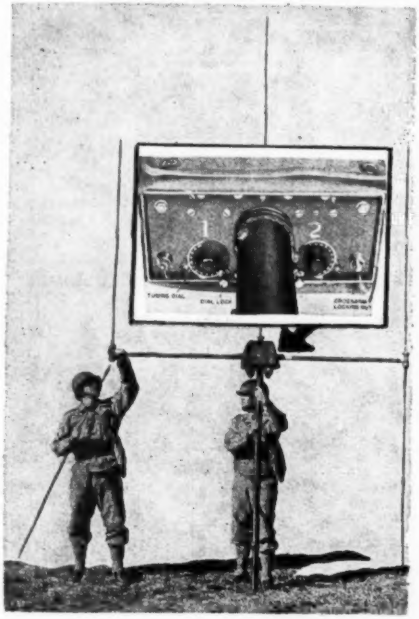
SLASHED TO .. EACH **$8.95**

MINIATURE STORAGE "A" & "B" BATTERIES. For Walkie-Talkies, Radio Portables, Radio-Controlled devices, Radio-Sondes, or equivalent meteorological devices. Supplied as a set of 3—"B" batteries of 36 volts each, and 1—"A" battery of 6 volts. Batteries dry-charged, less electrolyte and packed in a hermetically sealed vacuum metal container which prevents possibility of deterioration or loss of efficiency until opened and ready for use. Both "A" battery (BB-51) and "B" battery (BB-52) are ¾" deep x 1⅛" high x 3⅛" long, with 2 connection pins of ½" length protruding from each battery. Hypodermic needle required for acid—water filling 1280-1350 specific gravity. Full instructions supplied with each set of batteries for filling and charging. NEW-UNUSED, shipping weight 4 lbs. **PER SET** of 4 batteries as described. $3.95

PLEASE!! DO NOT REQUEST CATALOGUES! MATERIAL LISTED IS "HERE TODAY, GONE TOMORROW," AND CATALOGUES WOULD BE USELESS.

— SUMMER CLEARANCE BARGAINS —

HAM OR CB VERITICAL BEAM BARGAIN!



PRICE $17.95

TELEMARINE discovered this outstanding 3-Element Adcock Type Beam Antenna in Army Surplus. It includes a vertical dipole and phase-load tuning box, which permits tuning and phasing in the radiator and director elements, and phasing out the reflector element so that an unusually high front-to-back ratio results along with exceptionally high forward gain. Plug-in inductors permits use of this antenna over a frequency range of 20 to 40.0 MC. Operates with 52 or 72 ohm transmission line. Sturdy, weather-resistant construction! Operates satisfactorily with CDR-AR-22 Beam Rotator, or equivalent. New-Unused, with Instruction Book which covers complete equipment for which antenna was intended, but provides full installation and tuning-up data. Net wt. of beam 39.5 lbs. Shpg. wt. 102 lbs. Supplied with 2 plug-in inductors to cover 25-30 MC, installed in phase-load box. **COILS, PER PAIR** (2 required) for 20-22.5 MC; 22.5 to 25.0 MC; or 30-40 MC., specify freq. $4.95

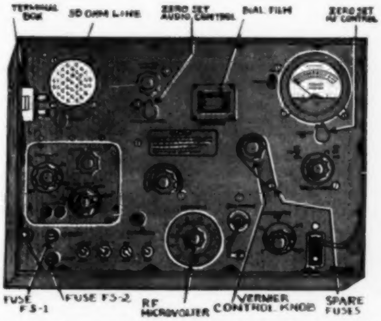
MALLORY UIBRACK, TYPE 6369, 12.0V. DC INPUT, output 275 at 85ma., or 250V, at 100 ma. Uses Synchronous Vibrator, no tubes necessary. Vibrator plug polarized for positive or negative ground. Dim. 5½" deep, 2¾" wide, 6" high. "Used—good" tested condition. Shpg. wt. 8 lbs. **PRICE, EACH** $6.95

COMMUNICATION ANTENNA BARGAINS! !

PREMAX TELESCOPIC VERTICAL ANTENNA, Chromed Monel Metal, 3 telescoping sections with watertight collet-type chucks to lock each section at desired length. Extends from 6 ft. 9 inches to a maximum of 19 ft. Excellent for Marine, Ham, CB, or Base short-wave operation. NEW-UNUSED units. Shpg. wt. 12 lbs. Originally price at over $90.00. Our **PRICE, ONLY** $14.45

30 MC MOTOROLA COAXIAL ANTENNA. Heavy duty, high-power construction. Easily modified by reducing length of upper whip section for higher frequencies, or increasing length by a few inches for CB application. Present length of top radiator 10". Equipped with female receptacle for PL-259 coax connector and 50 ohm line. Important mounting hardware included. UNUSED Units. Shpg. wt. 130 lbs. **PRICE, EACH** $14.95

HI-PRECISION FM SIGNAL Generator—Mobile Band



Model I-208, is a precision instrument worthy of the finest lab, mobile service and installation shop, or for production testing of mobile FM equipment. Previously, it was a scarce and expensive instrument, until we made a fortunate "buy" in a limited quantity. Freq. Range in 2 bands, 1.9 to 4.5 mc (for IF alignment and tests) and 19 to 45 mc. Freq. of output of signal is maintained with .03% of dial calibration over a temperature range from 0 to 60 degrees. Other outstanding features are: *Variable Frequency Deviation, 0-5 KC on 1.9 to 4.5 mc band, 0-50 KC each side of resting frequency on 19 to 45 mc band. *Calibrated Microvolter-Attenuator, adjustable up to 100,000 microvolts, developed at the termination of a 30-ohm line. Up to .84 volt available at high output terminals. *RF Vacuum Tube Voltmeter incorporated, 5 modulation frequencies provided by internal audio oscillator, 150, 400, 1,000, 2,500, and 5,000 cps. External modulation also provided for. *Operates from either 110 volts, 60 cycles AC, or 12 volts DC which is ideal for in the field work. *Crystal Calibrator, whose output is 1 mc and harmonics for checking and maintaining accuracy of signal generator. Each I-208 is supplied complete with tubes, calibrator crystal, 12V, DC Dynamotor and 110V. AC power supply are self-contained. Instruction Sheets and Schematic Diagram. Shpg. wt. is 145 lbs. (in wooden case). Available in NEW-Unused (tested) or Used-Excellent (not tested) condition. Act fast, our limited supply won't last long!

USED. EXCELLENT .... EACH $69.95

FM MOBILE BARGAINS, FOR SPECIALISTS

GE MOBILE FM, 152-172 MC, Model ES-12A, 25 Watts Output. Combination Transmitter Receiver, with built-in rugged 12.0 Volt DC Power Supply. Double conversion Superhet Receiver circuit, ideal for FM monitoring of hi-band FM transmissions. Used-Excellent condition, with all tubes, but less accessories. Shpg. wt. 50 lbs. **PRICE, ONLY** $49.50

COMCO FM, 152-172 MC MOBILE UNIT. Transmitter-Receiver and 6.3 Volt Power Supply in one housing. Single channel, crystal-controlled. Excellent for conversion to 110V. AC operation, for monitor application. Used-Very Good condition, with all tubes, but less accessories. Shpg. wt. 50 lbs. **PRICE, ONLY** $37.50

PHILCO 30-40 MC FM MOBILE TRANSMITTER, Model PRT-336T. Single-channel, crystal-controlled, with built-in 6.0 Volt Dynamotor Power Supply output of which is 600 volts at 175 ma. Excellent for conversion for Ham, CB, Emergency application and others. Used-Good condition, with tubes, but less accessories. **BARGAIN PRICE. ONLY** $19.50

PHILCO 30-40 MC FM RECEIVER, Model PRT-336. Single-channel crystal-controlled. Easily changed to 110V. AC operation, and will make an excellent, inexpensive monitor of Low-Band FM transmissions. Used-Good condition units, with tubes but less accessories. Shpg. wt. 35 lbs. **PRICE, ONLY** $22.50

RCA MODEL CTR-1A, FM TRANSMITTER-RECEIVER, 152-174MC. Ideal Base Station FM Monitor on "high-band." Has self contained loudspeaker, 110V AC Power Supply, Squelch & Volume Controls. Transmitter has 15kc deviation which can be modified to meet new FCC requirements. Power Output 15 watts. Receiver is double-conversion superhet. Single-Channel operation, "Used—Clean" Condition, with tubes and schematic diagram. Shpg. wt. 60 lbs. Not tested at the low price of **EACH** $40.95

All Above Material Subiect to Prior Sale. 25% Minimum Deposit with all C.O.D.'s. Min. Order—$5.00. All Prices F.O.B. Our Address.

WE BUY PRC, GRC, R-390 OR 391, SP-600, ETC. WE WILL PAY TOP DOLLARS FOR GOOD CONDITION EQPT.

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614	P.U.R.
616	P.U.R.
616A	900.00
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TEKTRONIX	
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2K28	18.00
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2K33	P.U.R.
2K33A	P.U.R.
2K41	P.U.R.
2K43	P.U.R.
2K50	P.U.R.
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4-250A	25.00
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6360	3.25
5894	17.50
7212	4.95
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Just a sample listing. We have or we can get anything fast . . . and at low cost. Call collect for your needs. All equipment first class: new or reconditioned. Export shipping and documents. Every shipment fully tested and guaranteed.

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TURN YOUR SURPLUS GEAR INTO READY CASH. WE ARE READY TO BUY NOW ANY OF THE ITEMS LISTED BELOW. CALL COLLECT NOW CY-9-0300 AND GET OUR BID. WE PAY CASH-ON-THE-BARREL, AND PAY THE SHIPPING CHARGES ALSO.

NAVY: TDH-4, or 231D Transmitters; "TED" Transmitters; AN/URR-35 Receivers; AN/URT-14 (complete); AN/SPS-10 Radar; AN/SPN-5, 7, 11, 18 Radar; Raytheon Pathfinder #1400, 1500

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Also looking for special purpose Tubes. TRANSMITTING, KLYSTRON, AND MAGNETRONS.

AIRCRAFT: AN/ARC-44, AN/ARN-14, AN/ARN-59, AN/ARN-67, AN/APN-70, AN/APS-31, AN/ARC-34, AN/ARN-21, AN/ARC-52, AN/ARC-38, AN/ARC-58, AN/APN-22, AN/APR-4

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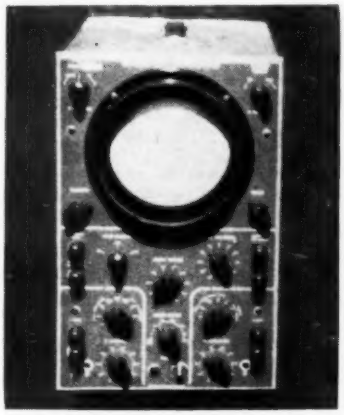
ELI HEFFRON & SONS, INC.

Air Force & Navy Surplus Materials

Electronic Equipment & Parts

10 lbs. of Scotch Cast Epoxy Resin with Catalyst, Type XR-5034 .... $6.00

Approximately 17,000 Ferrite memory cores $12.00

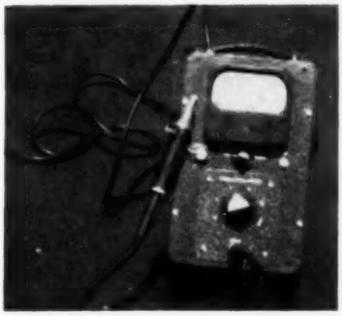


Dumont 304H Scopes $75.00

D6 Oregon 0-600 volt, 500mil regulated supplies $75.00

We have in stock a number of power supplies to a 100 volts up to 15 Amps, these supplies being regulated and/or transistorized.

Sorry we do not issue catalogs or lists.

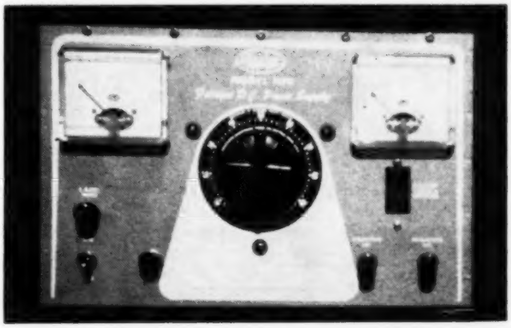


314 Ballantine Voltmeters $125.00

1500 watt Sorensen militarized electronic regulators $150.00

410B or 410BR Hewlett Packard voltmeters $125.00

KM75 Opad 0-32 volts, 5 Amp supplies $40.00



NFB Electro power supply, 0-32 volts, 15 amps .. $60.00

LA 7-3406

321-329 ELM STREET
CAMBRIDGE 39, MASS

EL 4-8572

Coaxial Cable & Connectors

RG8A with 2 **PL259**	
35 Feet	3.95
15 Feet	1.49
18 Inches	.98
Bulk (Foot)	.10

PL259	.39
SO239	.25
M359	.39
M258	.59
Double M	.98
"T"	1.75
UG175	.10
UG88	.39
UG290	.39

RG-54A/U. COAXIAL CABLE. 58 Ohms impedance. ¼" diameter. 385 foot rolls. Shpg wt 25 lbs. Cat. No. 1006CC21 .... **$9.95**

Tubes

2C39	6.00	5Y3	.40	715B	3.00
2C40	4.00	6AU6	.50	807	1.25
2C42	4.00	6CG8	.40	808	.75
2C43	4.00	6J4	1.25	813	8.75
2C44	.50	6J6	.40	815	1.95
2C46	3.00	6L6G	.98	832A	3.95
2E26	1.95	12AT7	.50	902PI	3.95
2K25	7.00	12AU7	.50	1625	.20
3AP1	1.75	12AX7	.50	5763	1.00
3C24	2.50	VR105	.50	5894	12.00
3C45	3.00	VR150	.50	6146	1.95
4X150A	8.75	371	2.00	6360	2.00
5C22	12.00	304TH	27.50	8012	1.00
5FP7	1.75	304TL	27.50	8020	2.50
5R4GY	1.00	416B	5.00	8025	1.00

Converter, Signal Data—This unit, just arrived, contains 25 tubes (12AU7, 12AT7, etc) 16 relays, (Plate plug in type) resistors, condensers, band pass filter, 5 unitized chassis etc etc
New equipment **$19.95**

IP243/ALA Scope—contains 3 WPI, 5-5814, 2-5670, 2-6AQ5, 2-5654, 1-5725—400 cycles power supply with plenty space for conversion. **$17.50**

BC221 Frequency Meter—Tip Top condition with original manual etc **$69.50**

R28/ARC5 Receiver—100 to 150 mc **$14.95**

Top Hat Rectifiers—600 PIV 200 ma **$.39**

Selenium Rectifiers 28v 1 amp. F.W. **$.79**

MN26C Receiver 150 to 1500 kc Some damage—mostly External **$4.95**

H58U—Head set—Navy Hi. Imp. **$3.95**

Panel Meters

0-9	"S" Hammarlund Super Pro.		Spec.	$2.95
0-20	Microamps DC	3½"Rd.		5.95
0-500	" "	2½"Rd.	Triplett	3.95
0-1	MA DC	3½"Rd.	Multiscale	3.95
0-1.2	"	2½"Rd.	G.E.	1.95
0-3	"	2½"Rd.	Marion	1.95
0-5	"	3½"Rd.	"	4.95
0-100	"	2½"Rd.	Triplett	2.95
0-1	Amp. DC	2½"Rd.	Weston	2.95
0-100	R.F. M.A.	2½"Rd.	G.E.	1.95
0-5	R.F. Amp.	2½"Rd.	G.E.	1.95

This is a partial Listing—many others in stock.
Send Addressed Envelope for Complete Listing.

Crystals

100 **KC**—Holder	1 3/16 x 1 5/8 x 2 1/8		2.95
100 **KC**—	"	1" Diam. x 2"	3.95
200 **KC**—	"	Octal	2.50
400 **KC**—	"	FT 241.	1.50
500 **KC**—	"	FT 241.	2.50
1000 **KC**—	"	Octal (for Freq. Meters)	3.95
1000 **KC**—	"	HC6 (Midgets).	2.95
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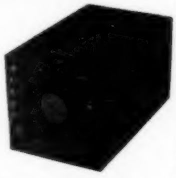

BC-929 is a compact radar display unit with 3BP1, 2-6SN7GT, 6C8G, 6X5GT, 2X2, 2-6H6GT; high-voltage divider from -1600 V; intensity, focus, and positioning controls; plus a DPDT motor-driven switch you can use for many automatic-switching functions outside of an oscilloscope.

BC-929 has been the TTY enthusiast's favorite foundation for a converter with cross-line scope presentation, and also the Amateur's favorite Modulation-Monitor foundation.

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BC453 (R23ARC5) 190 to 550 KC	**$12.95**
BC458 (T21) Transmitter 5.3 to 7 MC	4.95
R4ARR2 Receiver 234 to 258 MC Easily Converted to many frequencies	4.95
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RTTY—SSB—Phone Patch Transformer by Lionel	.95
RTTY—#255 Polar Relay	2.95
TN174—Antenna Tuner contains 244mmfd Jenings Variable etc.	1.95
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12vdc dpdt; 65 ohm coil 10A sil. cont. Advance 964B	2.00
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24vdc 4 pst no: 250 ohm coil 12A sil. cont. Leach 1274	3.00
24vdc 3pdt; 10a contacts, Leach 9031-8S. hs, wrap term	1.50
24vdc 40dt; 3a contacts Allied SKHX-12a. hs, hook term.	1.25
115vdc dpdt; 10k ohm coil 12a sil. cont., Leach type 1257	3.00
Pl, dpst nc; 5k ohm coil, 15 ma., Leach 1073BF	1.75
Pl, dpdt; 5k ohm coil, adj. cont., Leach 1037	2.50
115vac spst nc; dbl brk, 30a sil. cont., S-D type 84XXH	2.95

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115 vac spdt; 10a cont. Allied BNAX-1	5.50
Overcurrent: Adj. .04 - .16 adc, reset coil 115 vac Westinghouse type MN	6.50
Time delay pneumatic; Agastat NF-15; 24vdc coil adjust 0.5 sec. to 9 min., delayed make, inst. brk. two circuit contacts	3.50
Power, Arrow-Hart type RA 115 v 60cyc coil, 3pst no 25a, dbl brk contacts	15.50
Cramer motor driven time delay, operates on 115 v 60 cyc. 10 a contacts. Set at 120 sec. adj 0-120 seconds	7.50
Edison type 501 thermal delay, 115v heater, 45 sec delay n.o. contacts, plugs into octal socket	1.35

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Sangamo

Type A mica transmitting, 250 w.v.d.c., 5000 v.d.c. test. CM60B103J, 0.01 mfd. 5%	1.00
Type F1 mica transmitting, .0002mfd. 3000wv. 2.4 amps at 3mc. 1.2a. at 1 mc. CM65B201J	1.00
Type G3, transmitting mica, .004mfd. 15kv	32.50
Silver mica, 1500 mmf., CM30E152J	.20

Cornell-Dubilier

Medium power mica, .001 mfd. 6000v 10 amps at 3mc	5.00
Transm. mica, CM95F242J, .0024mfd, 30kv, 20a at 3000kc	99.50
Vertical mtg clamps for 1⅝" d. cyclinder caps	.05
Oil, screw base, both term. insulated from case, 10% tol. CP41B1FF205K, 2mfd. 600v	.75
Electrolytic threaded neck, 50 mfd, 400 vdc, CE41C5000Q. 50 mfd 400 v	.60

General Electric

Oil filled, 2 mfd. 10,000 v., CP70D1FS205K	32.50

Capacitors

Westinghouse type FP: 1 mfd. 10kv oil	17.50
Oil, 120mfd, 3000vdc, 5⅛x13⅛x15⅛ over. term.	38.50
Micas, transmitting, 1200 wvdc - $.35, 2500 wvdc	.85
Jennings type "U" vacuum var. 15kv. 50-250 mmfd	44.50

Johnson, type "M", miniature variable

Single section, 160-102/5M11—1.5 to 5 mmfd	.50
Single section, 20M11, 21-2.7 mmf	.95
Single section, 160-104.9M11—1.8 to 8.7 mmfd	.55
Butterfly, 160-205/5MB11—1.8 to 8.7 mmfd	1.10
Butterfly, 160-208/9MB11—2.2 to 8.0 mmfd	1.20
Butterfly, 11M11, 10.8-2.7 mmf	1.30
Differential; 160-303/5MA11—1.5 to 5mmfd	1.10

Hammerlund, variable

Screwdriver adj. MAPC-50, 50-3.2 mmf	.60
Screwdriver adj. MAPC-100, 100-4.5 mmf	.75
Screwdriver adj. with lock, APC-50-C, 50-3.9 mmf	.75
1000v. rms test, rotor stops, MC-20-S, 20-5.5 mmf	1.00
1750v. rms test, rotor stops, MC-50-MX-5d-10.5 mmf	1.50

Sprague, electrolytic

Threaded neck, 30mfd, 450vdc, CE41E200R, 30mfd 450v	.50
Plug-in type, 4⅝" H, 2000mfd, 15vdc, CE51A202E	.50

Centralab

Ceramic Trimmer, N650 temp. coeff, 822-BN, 45-7mmf	.45
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TS-12984 2500mfd 100v	1.75
TS-13985 1300mfd 150v	1.60
10-71864 2200mfd 150v	1.95
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SP11pos. 10a contacts, 111-11	2.50
Contacts 50a, 412-3, SP3pos	6.50
Contacts 50a, 412-9 SP9pos.	7.00

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Super jumbo 4 pin wafer for 8008, 122-244-200	1.10
Vhp septar for 826, 832, etc. 122-101-200	1.30
Giant 7 pin wafer, for 813, 4e27, 122-237-200	.70

Cinch Shield-base 7 & 9 pin miniature tube sockets

TS102C01 ceramic, 7 pin	.20
TS103C01 ceramic, 9 pin	.20

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Isolation, type R-76, 115-115v, 1200va, cord recept. UTC	24.50
S-46 plate, 1000-750-750-1000v at 300 ma UTC	14.50
S-14, output, pri 2.5k/4k/7k/10k, sec 500/15/8/2.10w	2.50
Type CG filament, pri 105, 115, 210, 220, 230v, UTC sec. 5vct at 25a. ins. for 5kv working, 11kv test UTC	8.50
Choke: filter; 2 hys. at 2 amps, 12.5kv test UTC	22.50
Herm. sealed, power, 650vct, 6.3 & 5v. 2a; 6.3v 4a, 3-9/16x-1/16x3-7/8 h. PMS-70A Chi-Tran	7.30
Herm. sealed filter choke, 8hy, 300madc, 60 ohm dc res. 3500vrms test. 4.57x4.12x5.32h. rb8300 hCi-Tran	7.47
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Leland rotary inverter, input 27.5 at 60a. output 115vac at 750va 3ph. 400 cyc pf or 0.9, and 26v at 50va 1ph 400 cyc pf of 0.4 continuous duty. Operating speed of 6000 rpm. 94-32270-A	29.50
General Electric silicon rectifier assembly. 3ph full-wave. max. working ratings for resistive or inductive load. Line to line ac input; 210vrms. dc output: 283v at 106 amps. 4JA6211CF1AB1	50.00
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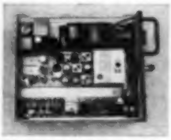
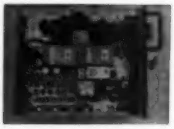
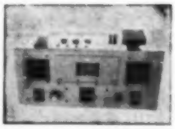


FMTR-80D
30W RF

FMTR-140D
60W RF



MOTOROLA T44A
18WRF 450MC



TT-63/FGC

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FMTR-80D	12V	30W	40-50MC	Clean with Dynamotor	44.95
FMTR-80D	6V	30W	30-40MC	"	34.95
FMTR-80D	6V	30W	40-50MC	"	39.95
FMTRU-80D	6V	30W	150MC	Clean, With Sensicon or unchannel receiver	44.95
FMTRU-80D	12V	30W	150MC	Clean, With Sensicon or unchannel receiver	52.95
FMTR-140D	6V	60W	30-40MC	Clean with Dynamotor	32.95
FMTR-140D	6V	60W	40-50MC	"	39.95
FMTRU-5V	6V	10W	150MC	Clean with case	25.95
FMTRU-5V	12V	10W	150MC	"	29.95
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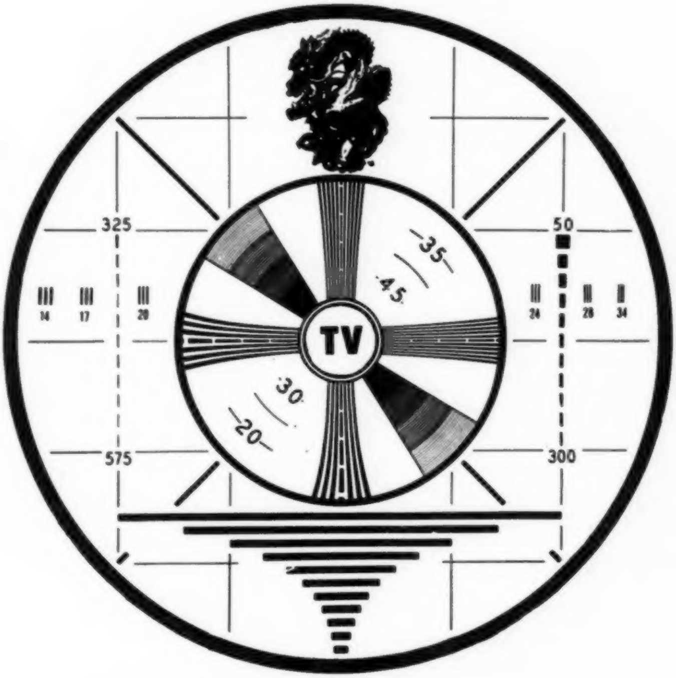

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Combined with suitable optical systems, this 3-electrode tube permits viewing of scene with infrared radiation. Scene to be viewed is imaged by optical objective upon semi-transparent photocathode. Spectral resp., S-1; good response up to about 1200A. Max. rating, absolute, grid #2, 20,000VDC or peak AC. grid #1,2700VDC. **$9.95 ppd.**

NT-6 WILLARD 6-VOLT STORAGE BATTERY

Rated 2.4 amp. hr. Approx. dimensions: 3½" l. x 1¾" w. x 2⅝" h. Weight: 1 lb. 3 oz. (plastic case) Dry-charged. **$2.50**

POTTER & BRUMFIELD RELAY

#SM5LS SPDT 8 000 ohm 11/16" dia. x 1 11/16" long. Approx. weight 1 oz. Hermetically sealed. Standard 7-pin miniature base. **$2.00**

MINOR SWITCH

10-position, 3-pole with stopper coil and reset coil 6-12 volts D.C. off-normal non-bridging wiper approx. dimensions: 4" long x 4½" high x 1⅝" wide, weight: 1 lb. **$9.95**

COLLINS PERMABILITY TUNER-OSCILLATOR

2 to 3 mc, 250 volt plate, 12.6 volt filament. Model 70E-2. New packaged.
PRICE ....**$12.50 each**

RT-82/APX6 TRANSPONDER

Good used condition· less tubes. **$9.95**

OIL CAPACITORS

1 mfd. 25,000 V. DC Westinghouse Interteen Type FP Style 1313854. **$39.95 each**

10 or more. **$35.00 each.**

GENERAL ELECTRIC FULL WAVE BRIDGE GERMANIUM RECTIFIER

input 117 volt AC, output 115 volt DC at 10 amperes approximate dimensions: 4¾" x 4¾" x 7½" long weight: 3½ lbs.
PRICE ......**$9.95 each**

TEST SCOPE—SYNCHROSCOPE—PULSE ANALYZER

ID-59/APA-11. Late production. Modular subassembly construction. Video amplifier is flat to 4 mc. 3BP1 presentation. Test-scope sawtooth 25-20,000 cy. Has all normal test-scope controls. As synchroscope and pulse analyzer, accepts positive or negative pulses. Video delay circuit permits leading edge of pulse to be seen. Calibrated-dial horizontal shift measures pulse durations from 0.5 to 100 microseconds. Sinewave-oscillator calibrator measures recurrence rates from 200 to 6000 pps accurate within 0.4.%. Built-in power supply requires 115v, 400 cy, 196 watts. External 60 cy power supply may be made to furnish plus 350 and—1300 vdc and 6.3 vac. In excellent condition, with all 19 tubes, schematic with parts values, parts-location pictures, operating instructions, theory explanation, and maintenance charts. Shipping weight 60 lbs. Used, good. Price each **$19.50**

RG 58A COAX CABLE

52 OHM, 100 ft. lengths $3.95

NICKEL CADMIUM BATTERY 1.2 VOLTS

Rechargeable thousands of times. Alkaline storage battery sintered-plate. Flat voltage curve during discharge. Will hold charge for long period of time. High discharge rate up to 50 amps. Spill-proof, may be used in any position. Approx. 6-ampere-hour capacity. Dimensions: 6" high; 2" wide; ½" thick. Approx. wt.: 6 oz. Uses potassium hydroxide (30% Electrolite). **$1.95**

SIGMA EXTRA-SENSITIVE PRECISION RELAY—SERIES 5F

Extremely precise, rugged DC general purpose sensitive relay. Balanced armature, single-pole, double-throw. Suitable for wide range of adjustments. Didimensions: 1¾"x1 5/16"x 1 11/16" high. Weight: 4⅛ oz. 5F-10,000S: 10,000 coil ohms. Operates 1.0 ma DC **$3.95**

POWER TRANSFORMER

Output: 12, 24, 36 volts. Input: 100 volts 60 cycles, single-phase. Will handle 2½ amps. Steel case is hermetically sealed, 3½"x 2¾"x4⅛". Wt. 3¼ pounds. **$2.95**

DIRECT-READING MAGNETIC COMPASS

Full-floating card, compensating magnets, and dial light avail. in 6- or 12-v. bulb. Luminous dial. Mfgd. by Bendix-Pioneer. 3¼" x 3¼" x 3½". 1¾ lbs.
$8.50 postpaid.

TCS DYNAMOTORS

12 volt D.C. input, 9.9 amps; output 440 volt D.C. at 200 ma new. **$7.95**

12 volt D.C. input, 3.6 amps; output 225 volt D.C. at 100 ma new. ......**$2.95 each**

RADIO COMPASS RECEIVER

B5/ARN7 Frequency 100 to 1750 KC Price **$17.50**
R5A/ARN7 Price **$27.50**
Loop LP21 LM Price **$12.50**
Control Box C4/ARN7 Price ....**$ 7.50**
Indicator 181A Price.................**$ 4.95**

VARIAC TYPE V20

input 120 volt AC 50/60 cycles output range 0-140 volts, 20 amperes.
PRICE ....**$37.50 each**

TYPE AN/ARN-6 RADIO COMPASS

Receiver R/101/ARNN-6, 100-1750 kc. in 4 bands. Excellent condition.
Price **$34.50**
Loop AS313-B. Excellent Condition. Price **$27.50**
Indicator ID91B/ARN-6 Excellent Condition.
Price ....**$ 9.95**
Mounts MT-273 or MT-274 Excellent Condition. Price Ea. ....**$ 9.95**
Control Box C-149A. Price **$15.00**

MANUAL

Handbook of operating instructions, general installation adjustment plus 5 pages of diagrams and Schematics. Price **$ 3.50**

ANTENNA WIRE

150 ft. stranded copper on windup reel complete.
PRICE ....**$2.95 ea.**

12 FT. TELEPHONE STRETCH CORD

3 conductor wire with JK-53 and a U31/GT plug.
PRICE ....**$1.49 ea.**

SILICON RECTIFIERS

All rectifiers listed at maximum peak inverse voltage ratings; approximate forward voltage drop, 1.5 volts.

1N1446	.075	amp.	100 volts	.50
1N1477	.075	amp.	200 volts	.60
1N1448	.075	amp.	300 volts	.75
1N1449	.075	amp.	400 volts	.85
1N1450	5	amp.	100 volts	1.00
1N1451	5	amp.	200 volts	1.25
1N1452	5	amp.	200 volts	1.50
1N1453	5	amp.	400 volts	2.00
1N1454	25	amp.	100 volts	3.00
1N1455	25	amp.	200 volts	3.50
1N1456	25	amp.	300 volts	4.50
1N1458	35	amp.	100 volts	3.50
1N1459	35	amp.	200 volts	4.00
1N05P7	50	amp.	50 volts	6.00
1N1462	50	amp.	100 volts	7.00
1N1466	75	amp.	100 volts	10.00
1N1467	75	amp.	300 volts	11.00
1N1468	75	amp.	300 volts	12.50
1N05V7	150	amp.	50 volts	16.50
1N1474	150	amp.	100 volts	17.00

X-BAND POWER LEVEL TEST SET, TS-36/AP

Brand new, in original packing, was accessories. Measures 10 to 30 dbm. 8700-9500 mc.
$14 95

RT-82/APX-6 TRANSCEIVER

Easy to convert to 1215 Mc Ham Station. Good Condition, Less Tubes........**$9.95**

TS-34A/AP OSCILLOSCOPE

This is ready to plug into 120 v, 60 cy. Used but checked out and OK'd, in carrying case, less cords which are easy to make. You look into light-shielding hood, thru a magnifying lens, and the small-tube picture is same as on a 5" screen. 0-40 db attenuators in 2 db steps are so accurate that you use as a VTVM. Video flat 40 cy-2½ mc. Contin. variable sweep 10 cy-50 kc. BEST OF ALL, there is a "Start-Stop" sw. position in which pulses to be viewed each trigger their own sweep; sweeps can be varied 4½-8, 20-50, and 120-280 microseconds so accurate and linear that you use to measure pulse width. INVALUABLE TO VIEW TV PULSES! Pulses may be periodic or random, pos. or neg., as low as 0.1 v. and from a pip to 200 u-sec wd. Built-in delay lets sweep start before pulse appears. AT THIS LOW PRICE NO ONE NEED DO WITHOUT THIS WONDERFUL SCOPE!
USED, GOOD CONDITION........**$29.95**

EC:335 2-CHANNEL FM TRANSCEIVER

30-39 mc. This unit is complete with 18 tubes operating from either 6 or 16 volts D.C. (Self-contained power supply). Crystal control, sensitive supreme circuit. Approx. dimensions 11" x 10" x 6". Approx. 24 lbs. Unit complete with tubes, schematic diagram and presetting instructions. Like new..**$25.00**

POWERSTAT TYPE 20

input 120 volt AC, 50/60 cycle output range 0-140 volts AC, 2 amperes.
PRICE ....**$8.95 each**

POWERSTAT TYPE 116

input 120 volts, 50/60 cycle output range 0-140 volts AC, 7.5 amperes.
PRICE ....**$16.95 each**

COAX CABLE RG59A/U

50 ft. roll complete with coax fittings.
PRICE ....**$2.49 ea.**

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Kit 35 Precision Resistors
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Kit 12 Electrolytic Cond's
Kit 65 Tubular Condensers
Kit 75 Mica Condensers
Kit 8 Crystal Diodes
Kit 200ft Hook Up Wire 4 Rolls, 50ft/ea. Assorted, Color

Kit 500 Lugs & Eyelets
Kit 10 Bathtub Oil Cond's
Kit 5 lbs Surprise Package
Kit 10 Transmit Mica Cond's
Kit 5 FT243 Xtal Holders
Kit 8 Xtal Osc- Blanks
Kit 4 Asstd Rectifiers
Kit 100 Self/Tap Screws

Kit 3 Phone/Patch Xfmrs
Kit 6 Insltd Tuning Tools
Kit 4 "Suncells" Asstd.
Kit 5 Sub-Min Tubes
Kit Adj Wire Striper & Cut
Kit Hi Gain Xtal Mike
Kit 2 pair SO239 & PL59
Kit 12 Binding Posts Asstd

Order Ten Kits—We Ship Eleven!!!
ONE EACH ABOVE KIT ONLY 99c

SELENIUM F.W. BRIDGE RECTIFIERS

One Year Grtd!

DC AMP	18VAC 14VDC	36VAC 28VDC	72VAC 54VDC	130VAC 100VDC
½	$1.00	$1.90	$3.85	$5.00
1	1.30	2.00	4.90	8.15
2	2.15	3.00	6.25	11.10
3	2.90	4.00	8.60	13.45
6	4.15	8.00	18.75	31.90
10	6.10	12.15	26.30	41.60
12	7.75	14.90	30.95	43.45
20	12.65	24.60	*Write For Rectifier Catalog*	
24	15.00	29.45		

Leece Neville Charger Systems
Sealed Silicon Stud Rectifier
Finned Stack, Direct Replacement
FOR 6 or 12VDC @ 100A,
Type YJ9 $18

SILICON TUBE REPLACEMENTS

TYPE	VRMS/PIV	AMPS	PRICE
T866	5000/10400	0.3	$16
T5R4	1900/2800	0.5	$7
5U4	1120/1600		$3.90
OZ4	UNIVERSAL		$1.50

GTD! POWER-DIAMOND-TRANSISTOR
Factory Tested
***MFGRD in U.S.A.
Replaces Medium & HiWattage Types
2N155, 2N156, 2N234, 2N256, 2N307, 2N554
35c each, 4 for $1

Two 866A's and FILAMENT XFMR 10 Kv Insltd SPECIAL! $6

DIAMOND BASE MICA MTG KIT $ .30
ROUND BASE MICA MTG KIT $ .30
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KIT TRSTB NPN or PNP. 35c ea.; 6, $2
1N34A DIODES ......19c ea.; 6 for $1

"TAB" BARGAINS

New Variacs/or equiv 0-135V/7.5A $15.30
New Variacs/or equiv 0-135V/3 Amp $10.65
DC-METER Dejur 800 Ma/2½" $3@
DC-MTR 100Ma/2½" ....$3@.
RF-MTG GE/475 Ma & 5 Amp $4@, 2/$7
DC-METER One Ma/4" Rd. ..$5@, 2/$8
SNOOPERSCOPE TUBE 2" ..$5@, 2/$9
MINI-FAN 6 or 12VAC/60 Cys $2@, 3/$5
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4x150 Ceramic/LOKTAL ..... 2 for $1.00
866A Xfmr. 2.5V/10A/10KV Insl. $3.95
Microswitch B1/SPNC/30 Amp 49c@.
Tube Clamps Birtcher ....5 for $1.00
.012 at 25Kv CD Condenser ....4@.
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Line Filter 50Amp/250VAC ..$10@.
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KS15138 Linear Sawtooth Pot. ..2 for $1.00
"CTC" Delay Line 1 Microsec'd $1@, 3/$2
Vacuum Condsrs 50Mmfd/7.5Kv $5@.
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THAT'S A BUY

"TAB" Tubes Factory Tested, Inspctd, Six Months Guaranteed! No Rejects! Boxed! GOVT & MFGRS Surplus! new & Used

OA2	.89	6BZ7	1.25	Buy & Sell	
OA3	.80	6C4	.45	43	.75
OB2	.65	6C5	.69	45	.49
OC3	.70	6C6	1.08	50L6	.69
OD3	.50	6C8	1.08	RK59	1.39
OZ4	.79	We Trade!		RK60	1.17
IA7	.90	6CB6	.89	HY69	2.20
IB3	.99	6CD6	1.49	75	.81
IL4	.82	6CF6	.85	HY75	5.00
IR4	5/$1	6CL6	1.40	83V	.95

We Swap Tubes! What Do/U Have?

IR5	.78	6CB6	.89	IPR60A	37.50
IS4	.78	6CG8	1.12	4-125A	27.50
IS5	.68	6CM6	.79	4X150G	15.00
IT4	.85	6CS6	.70	4X250B	41.00
IT5	.95	6CU6	1.29	4-400A	41.75
IU4	6/$1	6D6	.99	4E27A	39.00
IU5	.75	6E5	.79	250TL	19.45
IX2	.99	6F4	2.49	307A	2/$1
2C39A	Q	6F5	.63	316A	5/$1
2C40	5.50	6F6	.99	VR92	5/$1

Send 25c for Catalog!

2C43	6.50	6F7	.99	388A	3/$1
2C51	2.00	6F8	1.39	350A	2.45
2D21	.65	6H6	.59	350B	1.75
2E22	Q	6J4	1.72	371B	.95
2E24	Q	6J5	.59	6146	3.90
2E25	2.50	6J6	.59	416B	16.00
2E26	Q	6J7	.99		
2E30	Q	6J8	1.39	450TH	43.00
2E35	1.60	6K6	.59	450TL	43.00
2K25	9.75	6K7	.79	460	11.50

All Tubes Stocked at Low Prices!

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2K28	30.00	6L6	1.19	707B	3.50
2V3	2/$1	6SN7	.72	715C	10.90
2X2	.48	6T8	.98	717A	5/$1
3A4	.70	6V6GT	.90	723AB	5.00
3A5	1.00	6X5	.49	725A	2.75
3API	5.95	12AT6	.59	803	3.50
3BPI	3.99	12AT7	.89	804	8.85
3C24	3.50	12AU6	.63	805	6.00
3D23	3.95	12AU7	.69	We Trade!	
We Buy!		We Sell!		807 1.10 5/$5, 10/$12	
3E29	6.00	12AX7	.79		
3Q4	.68	12AY7	1.29		
3Q5	.86	12B4	.95		
4-65A	13.50	12BA6	.65		
4-125A	27.50	12BA7	.99	811	Q
4-250A	34.00	12BD6	.59	811A	Q
4X150A	Q	12BE6	.59	812	Q
4X250	36.00	12BH6	.79	813	9.95
4X500	Q	12BH7	.99	815	1.75
5API	2.95	12BY7	1.00	826	.99

Wanted Test Sets and Equipment

5BPI	Q	12BZ7	.99	828	9.00
5BP4	7.95	12H6	.75	829B	8.00
5CPI	4.99	12J5	.69	832A	6.00
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5T4	.90	12K8	.89	866A	2.25
5U4	.99	12SA7	.69	954	Q
5V4	.89	12SC7	.89	955	3/$1
5Y3	.60	12SF5	.69	957	3/$1
5Z3	.89	12SG7	.89	958A	2/$1

Send 25c for Catalog!

15GP22	89.00	12SH7	.89	991	5/$1
6A7	1.00	12SJ7	.75	1614	2.75
6A8	.99	12SK7	.75	1619	5/$1
6AB4	.59	12SL7	.79	1620	2.00
6AC7	.72	12SN7	.69	1625	3/$1
6AG5	.65	12SQ7	.69	1626	5/$1
6AG7	.75	12SR7	.69	1629	4/$1
6AK5	.69	15E	1.19	1050	1.25
6AL5	.59	15R	4/$1	5517	1.25
6AQ5	.66	FG17	Q	5608	3.95

Top $$$ Paid for 304TL, 813, 811A, 812A Tubes

6AR6	1.95	19T8	1.16	5618	3.25
6AS7	3.49	24G	Q	5651	1.35
6AT6	2/$1	25A6	1.19	5654	1.20
6AU6	.79	25A7	2.19	5656	4.25
6B8	1.35	25C5	.81	5663	1.15
6BA6	.59	25L6	.72	5670	.90
6BE6	.59	25T	4.00	5686	1.75
6BG6	1.49	25Z5	.72	5687	1.15
6BH6	.79	25Z6	.75	5691	4.70
6BJ6	.72	26A7	3.69	5725	1.95

Top $$$ Paid for XMTTR Tubes!

6BK7	.99	FG27	8.28	5732	2.00
6BL7	1.35	HV27	19.39	5736	85.00
6BN4	.69	28D7	.89	5749	1.95
6BN6	1.08	FG33	15.00	5750	2.75
6BN7	1.99	EL34	3.49	5751	1.25
6BQ6	1.19	35A5	.69	5814	1.20
6BQ7	.99	35L6	.59	5879	1.20
6BX7	1.11	35T	4.49	5894	12.00
6BY5	1.19	35Z5	1.25	No See—	
6BZ6	.91	RK39	2.99	Write!	

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U.S.A. Mfg

PNP 50Watt/15Amp HiPower TO36 Pckg! 2N441, 442, 277, 278, D5501 up to 50 volts/VCBO $1.25 @, 5 for $5. 2N278, 443, 174 up to 80v @ 2 for $5.
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PNP/Signal up to 350MW TO5. 25c @, 6 for $1
NPN/Signal IF, RF, OSC. TO5, OV5, 25c @, 6 for $1
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Pwr Transistors TO3/3A Untested 10 for $1
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2N1038/3A	Int Sink	40v	4 for $1
2N1039/3A	Int Sink	60v	3 for $1
2N1040/3A	Int Sink	80v	2 for $1
2N1041/3A	Int Sink	100v	1 for $1
2N538-39-40/3A small			2 for $1

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Factory Tested Gtd.!

NEWEST TYPE! LOW LEAKAGE

Piv/Rms 50/35 .05	Piv/Rms 100/70 .09	Piv/Rms 200/140 .12	Piv/Rms 300/210 .16
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ALL TESTS AC & DC & FWD & LOAD!

400 PIV @ 750MA Quantities 1000 $200
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D.C. Power Supply 115V/60 to 800 Cys. Output 330 & 165 VDC up to 150 MA. Cased SPECIAL $5.

Silicon Power Diodes Studs & P.F.*

D.C. Amps	50Piv 35Rms	100PIV 70Rms	150Piv 105Rms	200Piv 140Rms
3	.15	.20	.25	.35
12	.50	.70	.80	.95
*18	.30	.45	.60	.90
35	1.15	1.40	1.60	1.80
100	1.90	2.50	3.00	3.50
240	6.50	7.70	8.90	10.40

D.C. Amps	300Piv 210Rms	400Piv 280Rms	500Piv 350Rms	600Piv 420Rms
3	.45	.55	.65	.70
12	1.15	1.40	1.60	1.80
*18	1.10	1.35	Query	Query
35	2.50	2.75	3.25	3.90
100	4.00	4.75	5.75	8.50
240	18.50	27.50		

Sil. Pressfit 18A up to 100 Piv 4 for $1
Micro or MuSwitch CSD 35 Amp/AC-DC ..... 3 for $1

"SCR" Silicon Controlled Rectifiers!

PRV	7A	16A	PRV	7A	16A
25	.60	1.00	200	2.70	3.00
50	1.00	1.35	300	3.00	3.45
100	1.60	2.15	400	3.75	3.90
150	1.95	2.45	500	4.75	4.30
200	2.20	2.80	600	5.45	5.65

SCR KIT UNITS UP TO 25-AMPS UNTESTED ....4 for $2

Silicon Diodes 3&6 Amp Studs Untested .12 for $1
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Now in our fifth year, and still growing

Selenium Rectifiers, 3-phase, 14 volts, 60 Amps. Leece-Neville #30605, for use with Leece-Neville Alternators. Shpg. Wt. 6 lbs. **$7.73**

Selenium Rectifiers, single-phase, full-wave bridge 55 volts, 3 amps. 3½" x 4½" x 8½". Useful for powering surplus relays, motors, etc. 3 lbs. **Only $1.00**

APX-6 IFF Set. Transceiver for 1296 MC. With 31 tubes. Used, good. Shipping Wt. 50 pounds. **$16.50**

Collins ART-13 Transmitter, complete with tubes, less calibration book. Excellent used condition. Shpg. wt. 90 pounds. Limited quantity at **$40.00.**

BC-221 Freq. meter, with xtal & original calibration book. No modulation. Excellent used condition. Limited quantity **$75.00**

3BP1 Cathode Ray Tubes **$2.49**

2E25 tubes. Special **75c each. 4 for $2.50**

Plate Transformer 390-0-390 v. 450ma. Use in bridge circuit for 750 volts, 300 ma. 4½ x 6 x 6½". 20 lbs. **$4.00 each. 3 for $10.00**

Power Transformer, 350-0-350 v. 130 ma., 5v, 3 A., 6.3v. 3.6A. 3" x 3¾" x 3½". Uncased. 7 lbs. **$1.95**

Output Trans. 8000r P-P to 4, 8, 16, 500r. 15 watts. 3 x 3½ x 3½". Upright mounting with end bells. 4 lbs. **$2.00**

Modulation Transformer. 1.75 to 1 ratio. For 807, 1625, 6146, etc. 100 watts. Fully enclosed use, 4 x 5 x 5", 13 lbs. **$3.95**

Scope Transformer, 2750v. @ 6ma., 220-0-220v. @ 224ma. 135v. @ 8ma. Oil-filled. 3½" x 4¼ x 5". 12 lbs. **$2.00. 3 for $5.00**

2-METER STATION

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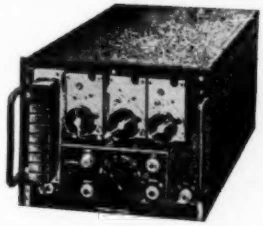

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BC-191 1.5 to 12.5 MC	New:	34.95
BC-230 3000 to 7000 KC	Used:	8.95
T-17/ARC-5 1.3 to 2.1 MC	New:	14.95
T-18/ARC-5 2.1 to 3.0 MC	Unused:	8.95
T-21/ARC-5 5.3 to 7 MC	New:	8.95
T-20/ARC-5 4.0 to 5.3 MC	New:	9.95
BC-459 7.0 to 9 MC	New:	14.95
T-23/ARC-5 100 to 156 MC	Used:	18.95
T-67/ARC-3 100 to 156 MC	Used:	22.95
GP-7 350 to 9050 KC	New:	34.95

RECEIVER-TRANSMITTERS:

RT-58/ARC-12 230 to 250 MC	Used:	$29.50
BC-745 AM 2 to 6 MC	New:	19.95
LINK 1905-1906 152 to 172 MC FM	Used:	59.50
AN/VRC-4 1.7 to 8.7 MC	Unused:	59.95
RT-19/ARC-4 140 to 144 MC AM	Used	22.95
BC-1335 27 to 38.9 MC FM	As is Used:	6.95
SCR-522 100 to 156 MC AM	Used:	29.95
BC-645 (Converts to: 435 to 500 MC)	New:	14.95
RU-18 Complete Set, 12 Volts	New:	19.95
RU-19 Complete Set, 24 Volts	New:	19.95

TELEPHONE-TELETYPE-TELEGRAPH:

Model 14 AT Teletype	Used:	$89.50
Paper Tape ⅜" 900 Ft. Roll 25c—30 for $3.00—60 for		$5.00
Telegraph Repeater WE-61824A	New:	39.50
TP-7 Portable Repeater	New:	12.95
TG-30 Telegraph Repeater—Used: $14.95 or	New:	19.95
TG-31 Telegraph Repeater	New:	16.95
PE-250 Telephone Ringer	Re-New:	7.95
EE-8 Field Telephone	Used:	12.95
BD-71 Swtichboard—6 line	Used:	9.95
BD-72 Switchboard—12 line	Used:	18.95
BD-89 Switchboard—20 Mag. & 40 CB lines	Used:	59.50
BD-95 Switchboard—Cordless	New:	24.95

MICROPHONES:

T-30 Throat Microphone: Used 3/1.00	New:	$ .7
T-45 Lip Microphone: Used @ 65c ea.	New:	1.0
RS-38 Microphone Button only	New:	1.5
T-17 Microphone Carbon: Re-Cond: $5.95	New:	7.5
T-26 Microphone Carbon: Used: $1.00	New:	1.7
T-24/M Microphone Carbon	New:	4.9

RECTIFIERS-POWER SUPPLIES:

RA-87 Rectifier for Teletype	New:	$ 8.9
RA-62 AC Power Supply for SCR-522	Used:	59.5
PP-855/PRC-14 6 Volt DC Pow. Sup.	New:	4.9
PP-18/AR 12 VDC to 28 VDC 1.5 Amp.	New:	7.9
BC-603/683 AC Power Supply:	Kit $10.00—Wired:	14.9
R-77/ARC-3 AC Power Supply:	Kit $15.00—Wired	19.9
BC-923 AC Power Supply	Kit $16.00—Wired	20.9
BC-652 AC Power Supply	Kit $15.00—Wired:	19.9
AC Power Supply with Speaker—Command Receivers **BC-348, 342, 344, 429, & RAX:**	Kit $15.00—Wired:	18.9

DC SUPPLIES:

All operate from 115 Volts 60 cycles:

DUAL OUTPUT—12/14 or 24/28 VDC @ 6 Amps—	Parts Kit: $20.00—Wired Complete:	$24.95
OUTPUT—12/14 VDC @ 6 Amps. Size: 5½ x 9½ x 5"—	Parts Kit: $14.00—Wired Complete:	$18.95
OUTPUT—24/28 VDC @ 4 Amps. Size: 5½ x 9½ x 5"—	Parts Kit: $13.00—Wired Complete:	$17.95
OUTPUT—12/14 VDC @ 4 Amps. Size: 5½ x 9½ x 5"—	Parts Kit: $10.00—Wired Complete:	$14.95

AMPLIFIERS:

AM-26/AIC—4 Tubes	Used:	$3.95
AM-203/ARA-19—3 Tubes	New:	3.95
AM-142/AIC—1 Tube	Used:	1.25
TCS-CMX50L28 2/12A6 Tubes	New:	2.95

INDICATORS:

T-9 TRACKER RADAR—5" CR	Used:	$27.95
ID-169/APN-12 Radar Range 3"	Used:	9.95
ID-80/APA-17 Radar Range 5"	New:	16.95
R-61/ARG-5 Panoramic Rec. 5" 18 to 80 MC.	New:	49.50
GPA-23 Monitor Scope 3"	Used:	12.95
24360 Foundation—5" Scope	Used:	5.95

CODE EQUIPMENT:

TG-34 Keyer—Code Practice	Used:	$24.95
TG-10 Keyer—Code Practice	Used:	14.95
VO-3 Code Oscillator	Used:	12.95
MX-333/GG Code Tape Puller	New	12.95
Blank Paper Tape ⅜" 900 Ft. Rolls 25c ea.	30/$3	60/$5

HANDSETS:

TS-9 Butterfly switch	Used: $2.95—Re-Cond:	$ 3.95
TS-13 Butterfly switch w/PL-55/PL-68	Used:	4.95
	New:	6.95
H-22/U Butterfly switch w/PL-55/PL-68	Used:	4.95
D170312 Sound Powered	New:	7.95

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HS-33 Headset: with chamois cushions	New:	$ 7.95
with rubber cushions	New:	6.95
HS-23 Headset: with chamois cushions	New:	6.95
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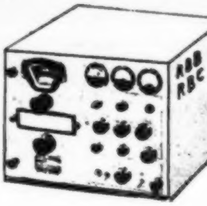

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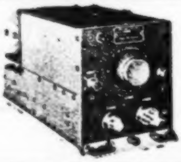

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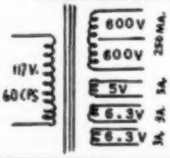

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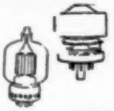

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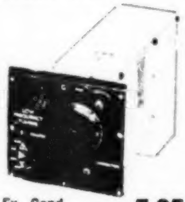

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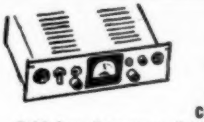

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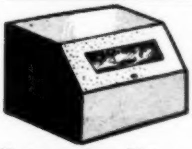

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Radar Principles-Simplified

Gordon Hopper W1MEG

Although radar is not one of the forms of communication generally used by radio amateurs, the author feels that amateurs should have a "speaking acquaintance" with this very important and fascinating phase of electronics. Possibly reading this article may capture your interest enough to cause you to investigate in detail what makes a radar "tick." In any case, we hope that this article will clear up some of the questions you may have had about radar.

Introduction

The word RADAR is made up by extractions from the phrase "RAdio Detection and Ranging." Basically, radar is the application of radio principles to detect unseen objects and to determine their direction and range. In special types of radar, elevation and speed may be indicated also.

Radar is one of the greatest scientific developments to come out of World War 2. Its basic principles are relatively simple, and the seemingly complicated circuits can be resolved into a series of functions that, when taken individually, will afford identification and understanding.

Basic Principles

The basic principle of radar operation is dependent on creating (transmitting) and picking up (receiving) an echo. A radar transmitter emits powerful, short bursts of rf energy. Some of this energy will strike objects within the range of the transmitted signal and be reflected back to the radar receiver. It is possible to determine the distance of the object causing the reflected signal to return by carefully measuring the time required for the energy to go to the object and to return, and then translating this information into a measure of distance.

Sound echoes or wave reflection is the principle used in radar operation. If a person shouts in the direction of a sound-reflecting surface 2200 feet away, he will hear his shout return in about 4 seconds. If a directional device was built to transmit and receive sound, the principles of echo and a knowledge of sound velocity could be used to determine the distance, the height, and the direction of an unseen object.

All radar sets work on principles much like these in the preceding paragraph except that a radio wave of extremely high frequency is used instead of a sound wave. The radar set transmits a short pulse of rf energy and receives its own echo signal, then transmits another pulse and receives these echoes. Depending on the design of the radar set, this cycle is repeated 60 to 4000 times each second. If the energy is sent into clear space, there will naturally be no returning echoes and the energy is lost. If the energy strikes an object such as a building, ship, airplane, or hill, some of the energy will be reflected back to the radar's antenna and receiver. If the object is large, a strong echo (but only a fraction of the radiated energy) is returned to the antenna. If the object is small, the echo will be weak. Radar waves travel at the speed of light, approximately 186,000 land miles per second or approximately 162,000 nautical miles per second. Radar signals have been directed to the moon and their echoes have been received approximately 2½ seconds later.

Because radar utilizes the uhf and the shf bands, the energy will travel in a straight line with very little effect from the earth's atmosphere. Consequently, there is a very short time interval between the transmission of a radar pulse and the reception of its echo. It is possible to measure the amount of elapsed time to an accuracy of one ten-millionth of one second (1×10^{-7} seconds). The forming, timing, and presentation of these pulses are accomplished by special circuitry and devices.

The antennas used by a radar set are designed with a sharply defined beam. When a signal is being received, the antenna will be rotated until the received signal is maximum. The direction of the target (object) is then determined by the position of the antenna.

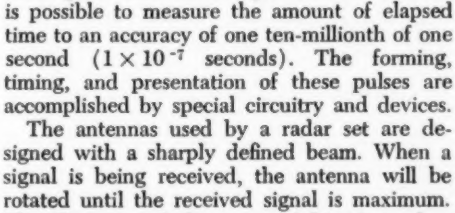

FIGURE I

Fundamental elements of a radar system

The echoes received by the radar receiver are observed on an oscilloscope (built as part of the radar) as marks of light. This scope may be calibrated in miles, yards, or degrees. A radar operator can tell the bearing and range of a target by the position of the echo on the scope indicator.

Azimuth is the relative horizontal direction of a target with respect to some particular direction reference expressed in degrees. Elevation expresses the angular degrees that the target is above or below the radar set. Both azimuth and elevation must be considered in determining the direction of a target. The determination of both azimuth and elevation depend upon the directional characteristics of the radar antenna.

Types of Radar Systems

There are several radar systems in current use, each with major differences between them. They are the frequency modulation system, the frequency shift system, and the pulse modulation system (most commonly used today.)

Frequency Modulation System. Because each cycle of a frequency-modulated wave differs by a small increase in frequency from the others of that wave, a frequency-modulation system makes it possible to identify each cycle of the transmitted wave and to recognize it from all others when it returns to the receiver. If a transmitter is designed to produce a signal which regularly changes over a known range of frequencies, it is possible to identify any particular reflected signal cycle. Two separate signals are fed to the receiver and, when mixed, produce a beat note. The frequency of the beat note varies directly with the distance to the object, increasing as the distance increases. A device that measures frequency can be calibrated to indicate range (distance to object). A measurement of the difference in frequency between the transmitted and reflected energy determines the presence and speed of a moving target. The frequency-modulation system works well with stationary or slow-moving targets but not as well with fast-moving targets.

Frequency Shift System. This is based on the Doppler effect. If the source of radio energy (an aircraft from which radio waves are reflected) is moving rapidly, the frequency of the echo return signal will change provided that the object is moving toward or away from the receiving antenna. The circling of an aircraft (or cross-wise movement) will not change the frequency. The amount of frequency change is proportional to the speed at which the object is moving toward or away from the receiving point. The detector in the receiver responds to the difference in frequency. If the object is not moving, or if it is moving crosswise, the detector response is zero. In a mountainous area where the echo return signals are stronger than the echo return signals from an aircraft, the frequency shift principle is sometimes combined with a pulsed radar system. The moving objects are differentiated from the stationary ones, the stationary objects are eliminated, and the operator sees only the moving objects. In this type of system, the frequency shift detector device is supplementary equipment attached to the radar set and is called a moving target indicator.

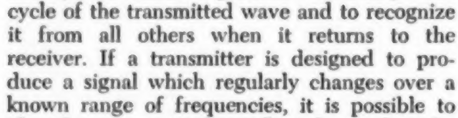

FIGURE 2
Simplified block diagram of a modulator and Transmitter

Pulse Modulation System. Most radar sets employ the pulse system of deflection. In this system, the transmitter is turned on for short periods and off for long periods. When the transmitter is on, it radiates a short burst of energy called a pulse. This pulse will strike an object, part of the reflected energy is returned to the receiver, and is displayed on a cathode-ray tube. As the transmitter is turned off after every pulse, it does not interfere with the receiver. Complete location of an object in space depends on the range or distance of the target from the antenna and the direction including both the azimuth and elevation directions. The primary purpose of a radar set is its ability to measure distance in terms of time. In useful terms for radar, radio waves travel one nautical mile in 6.2 microseconds, or one radar mile (out and back) in 12.4 microseconds. If a pulse of energy was transmitted toward a target and the echo returned 620 microseconds later, the distance of the target would be 50 miles.

$$\frac{620}{12.4} = 50 \text{ miles}$$

In the pulse system, the time duration of the pulses may vary from 0.1 to 50 microseconds. If the transmitter is turned off before the reflected energy returns from the target, the receiver can distinguish between the transmitted pulse and the reflected pulse. After the reflections have returned, the transmitter can

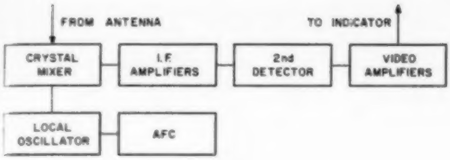

FIGURE 3

Simplified block diagram of a radar receiver

be turned on again and the process repeated. The receiver output is applied to an indicator that measures the time interval between the transmission of the energy and its return as a reflection.

Fundamental Radio Concepts

The fundamental elements of a radar system consist of the transmitter, modulator, antenna, receiver, indicator, and power supply. A functional diagram of a simple radar system is shown in Figure 1. Figure 2 shows a simplified block diagram of a transmitter and modulator and Figure 3 shows a simplified block diagram of a receiver.

The transmitter provides extremely high-power pulses of rf energy for a very short time. The frequency must be very high to allow many cycles to get into the short pulse.

The modulator produces the synchronizing signals that trigger the transmitter the required number of times each second. It triggers the indicator sweep and coordinates the other associated circuits.

The antenna is very directional and usually is a dipole used in conjunction with parabolic reflectors. Ordinarily, one antenna is used for both the transmitter and the receiver and a switching device is used to connect it to the transmitter when a pulse is radiated, and to the receiver during the interval between pulses. The antenna is a rotatable array and continually searches for targets within its range.

The receiver is usually a superheterodyne type, is very sensitive, and is capable of accepting signals within a 1 to 10 megacycle bandwidth. It presents video pulses to the indicator.

The indicator presents necessary information to locate a target on the indicator screen. The method of presentation is called "scan." There are about 15 types of scan used in radar receivers but the most common ones are: type A, B, PPI, and E.

The power supply furnishes all ac and dc voltages to the radar system.

Certain parameters are associated with all radar systems. These parameters consist of carrier frequency, pulse-repetition frequency (PRF) (the number of pulses sent out each second), pulse width (in microseconds), and power relation (relationship of peak and average power).

The carrier frequency is the frequency at which the rf energy is generated.

The range of a radar set depends upon the pulse-repetition rate provided the power is sufficient. For example, if the repetition rate is 250 pulses per second, the period of time is $\frac{10^6}{250} = 4000$ microseconds. At 12.4 microseconds per mile, the range will be $\frac{4000}{12.4} =$ approx. 322 miles.

The minimum range at which a target can be detected is determined largely by the width of the transmitted pulse. For example, a pulse width of one microsecond will have a minimum range of 164 yards. A target within this range will be blocked out on the indicator. For radar navigation work, the pulse width is normally in the order of 0.1 microsecond. For long range work, the pulse width is normally from 1 to 5 microseconds.

The transmitter's useful power contained in the radiated pulses is called peak power. The transmitter's average power is low compared with the peak power. The greater the pulse width, the higher will be the average power. The longer the pulse-repetition time, the lower will be the average power. Duty cycle is the fraction of the total time that rf energy is radiated. This is represented as

$$\text{duty cycle} = \frac{\text{pulse width}}{\text{pulse-repetition time}}$$

High peak power is desirable to produce a strong echo return and low average power is desirable to keep the equipment compact.

Summary

Throughout the years that radar has been in use, it was pioneered and developed primarily by the various military services. In addition to being used by the military, it is used by civilian organizations for:

1. Determination of vehicle speeds on highways,
2. Radar weather prediction,
3. Commercial air navigation, and
4. Safeguarding aircraft and merchant ships from collision hazards.

Radar equipments are grouped into many classes, but in general it can be said that some of the classes are air search, surface search, fire control, identification, ground and carrier-controlled aircraft approach, range rate or speed, and height finding. . . . W1MEG

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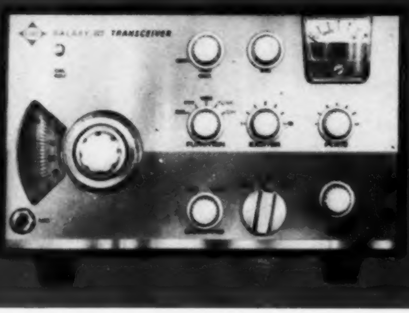

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